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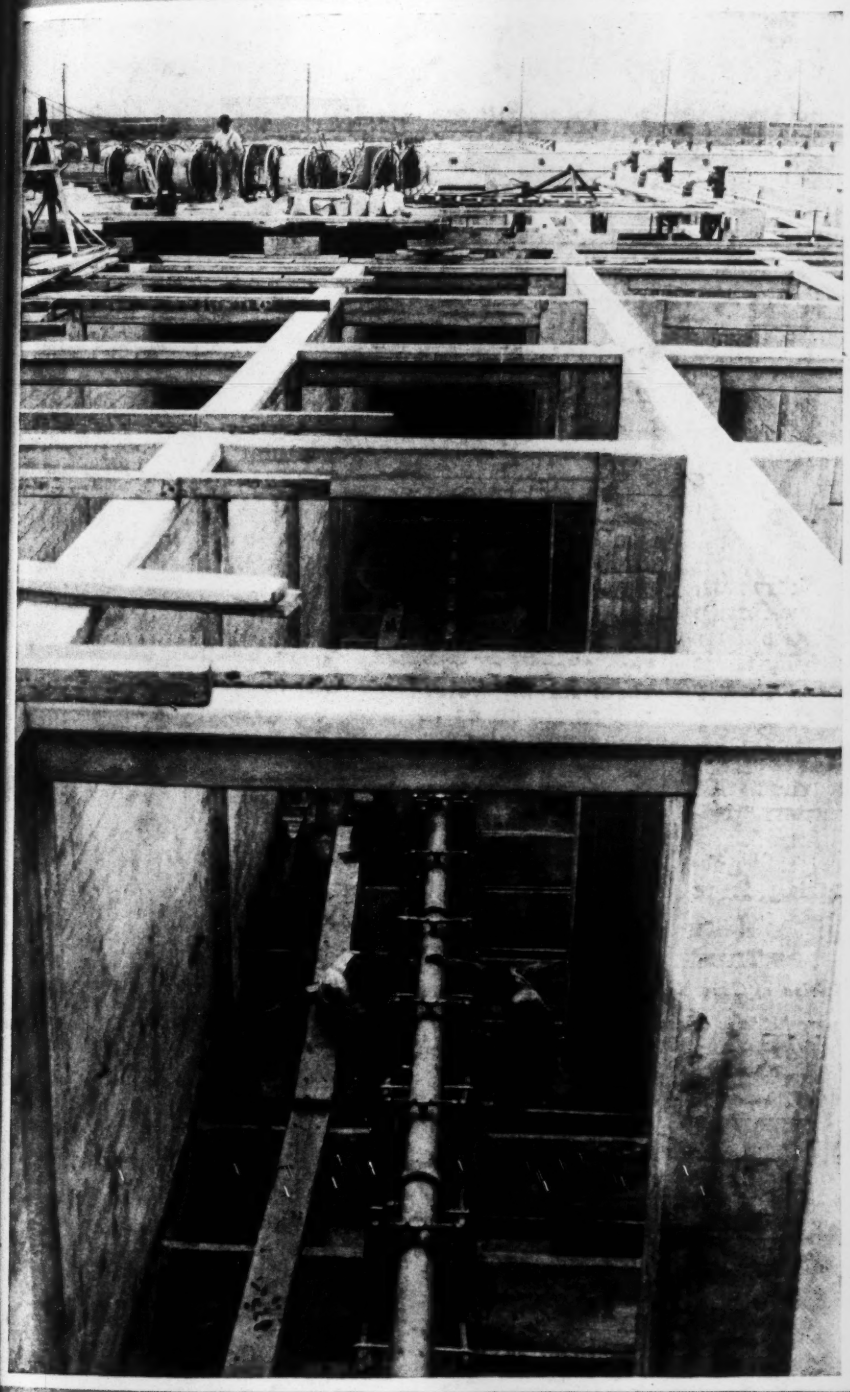

Sewage Treatment in the Chicago Sanitary District

By Langdon Pearse

Changes since plants now in service were described —Sludge-handling equipment and early operation experiences

Remove Subaqueous Ledge Above Rapid Transit Tunnel

By Col. Edward Burr

Special precautions safeguard New York subway tubes during channel improvement—Fire blasts between trains and maintain close inspection

Fundamentals of Highway Department Organization

A paper read before the Association of State Highway Officials by A. R. Hirst, State Highway Engineer of Wisconsin

From Job and Office

Six full pages of short articles, each telling how a specific problem was solved by an engineer or a contractor

Looking into one of the aeration tanks of the Des-Plaines Sewage Treatment Plant of the Chicago Sanitary District

"GMC TRUCKS ARE SEVEN STEPS AHEAD"

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, DECEMBER 14, 1922 — Number 24

As to Highway Location

SO MANY of our readers have been moved to comment on the subject of locating skill in highway engineering, raised by R. S. Blinn in *Engineering News-Record* of Nov. 9 and discussed editorially in the same issue, that we will publish in the highway issue of Jan. 11 a selection of extracts from letters that have been received or that may be received in time for publication.

Professional Ideals

IT HAS often been said that the ideals which actuate some engineering societies depart from the strictly professional viewpoint and have a commercial flavor. Such viewpoints are difficult of definition; departures from them are measured largely by individual opinion. Examples, though, enable one to illustrate the difference between the professional and the commercial attitudes. Last week at the annual meeting of the American Society of Mechanical Engineers one of the sessions was broadcast by radio. The object was laudable. The session was devoted to a discussion of human relationships in industry, about which sound thought deserves a wide hearing. In introducing *each* speaker, the chairman announced that the speech was being broadcast by the courtesy of the Radio Corporation of America and the Westinghouse Electric and Manufacturing Co. The repetition became monotonous and ludicrous—as the laughter of the audience proved. An announcement at the opening of the session regarding the broadcasting arrangements was, of course, called for. It is to the repetition, featuring the commercial elements involved, that the professional spirit objects. Possibly the broadcasting privilege could not have been bought in any other way. We are inclined to believe, however, that a society with stringent professional ideals would have considered the price too high. Some will argue that the resulting benefit to the public and the advertising of the American Society of Mechanical Engineers justified the means. With that viewpoint we cannot agree. We believe, too, that the number of engineers is still large who feel that such injection of a commercial flavor does not comport with the ideals which should dominate a professional society.

The Coming Road Convention

EVIDENCE is available on every hand indicating that the forthcoming convention of the American Road Builders Association and the Good Roads Show in Chicago, Jan. 16-19, will be an event without precedent in the history of American highway development. Never before has interest been so keen and so widespread. A technical program has been planned with extreme care to cover the major topics of road construction, maintenance, design, finance, economics, and traffic, and the leading men in the field have been secured to contribute papers and participate in the discussion. As for the exhibit of road-building equipment and materials, it is sufficient to say that the space available for the display of these products was oversubscribed twice by prospective exhibitors. The prediction can be confidently made that this year's convention and show will measure up in size and quality to the great industry it represents. More than that could not be desired. This prediction is reflected clearly in the twenty-three page announcements of the Chicago meeting which appears in the advertising pages of this issue; the space for it was donated by manufacturers as part of a comprehensive, forceful plan to arouse the entire industry to the opportunities offered by the forthcoming meeting. This twenty-three page advertisement is expressive of the spirit in which the committee responsible for the convention and show are working.

Mutual Benefits from Winter Buying

REASONAL fluctuation in activity is grouped with inefficient methods and transportation difficulties to form the eternal triangle of the construction industry. In one field—that of cast-iron pipe—a discussion has been in progress in these pages for several weeks past dealing with the feasibility of spreading purchases throughout the twelve months of the year instead of concentrating them during the summer. Last week, the discussion was concluded by Thomas F. Wolfe, official spokesman for the pipe manufacturers. His rebuttal carries a significant message to water department officials and other users of pipe. The one point of common interest in the matter of winter buying is price. Mr. Wolfe points out that "the manufacturers realize that if winter buying is to be encouraged, the buyer must profit." If purchasers would co-operate with producers by placing orders, where possible, during the cold months, substantial economies in production costs could be realized and these savings, according to Mr. Wolfe's definite statement, will be passed on by manufactureres to purchasers in the form of reduced prices. The pipe buyer, however, is human. He wants something more definite than the assurance that he will share in the production savings effected by winter purchases. He has been paying a certain price for pipe bought largely during the summer. Assuming that through some central agency, it were possible to prepare an approximate estimate of the aggregate tonnage of orders that might be placed this winter, what reduction in price below present levels can be expected? To be convincing and to serve as the basis of nationwide action by the buyers of pipe the manufacturers must be in a position to supply something fairly specific as to the actual amount of price reductions in the event of orders for certain definite tonnages. This being assured, the pipe users, through the technical societies interested, could well go ahead on a constructive program looking toward winter buying of pipe.

An Industrial Message to Congress

STRIKING testimony to the fact that our national problems are mainly industrial problems will be found in President Harding's message to Congress. Of some eight or nine major topics he selected as of outstanding importance all but two or three deal with primarily industrial problems and several are affected with a decidedly technical interest. They include the proposal to consolidate the railroads into a limited number of systems, the pooling of equipment and terminal facilities; changes in the powers and scope of the Interstate Commerce Commission that would enable it to take over the functions of the present Railroad Labor Board, the regulation of immigration, child labor, restriction of the issue of tax-exempt securities by communities, and the so-called superpower program for the eastern industrial region.

The Railroads

As to the railroad situation in general, the President defines problems and indicates possible solutions, but he lays down no definite proposals. He presents as "suggested ways of economy and efficiency" the merger of lines into systems, the pooling of freight cars, and the consolidation of terminal facilities. He thinks well also of a central agency under the control of the railroads to provide means of financing equipment for carriers unable otherwise to provide their share.

The merger of lines into systems, which may well be the key to the rest of his suggestions, is now under discussion by the Interstate Commerce Commission and the carriers. Developments so far point to the improbability of any such step being taken voluntarily by the roads on the basis of the tentative groupings laid down by the commission. The roads are willing to consolidate providing they can pick their own partners. Such a procedure almost certainly would result in no provision for the weaker roads whose plight had much to do with the origin of the merger proposal. Grave doubts prevail as to the constitutionality of the compulsory consolidation that has been suggested, but there remains always the possibility of adjustment under government sponsorship of the differences that now stand in the way of mergers held to be desirable in the public interest.

The President regrets that when the freight rates were reduced last summer he was unable to prevail upon the railroad managers to accept a rational readjustment geared to our economic needs, rather than the horizontal reduction which dissipated on unessential commodities savings that might have been of material help had they been concentrated on the heavy tonnage of the basic industries. As was expressed at the time of the decision, *Engineering News-Record* shares that regret.

Railroad Labor

In urging that decisions of the railroad labor tribunal shall be enforceable, President Harding points out clearly the distinction between private employment and employment affected with so pronounced a public interest as that on the railroads. "No man," says the President, "can be denied his right to labor when and how he chooses, or cease to labor when he so elects, but, since the government assumes to safeguard his interests while employed in an essential public service, the security of society itself demands that his retirement from the service shall not be so timed and related as to effect the destruction of that service." The President is on solid ground in this stand, and there is reason to hope that by this time both medieval railroad executives and predatory labor leaders have come to understand that the day of the "private fight" is over. Surely they must have learned how meager is the net return to either from the waging of industrial warfare. It is hoped that Congress will absorb a measure of the President's courage and enact this principle into law.

Tax-Exempt Securities

In returning to his proposal for a constitutional amendment that would permit restriction of the issuance of tax-exempt securities by governmental units, the President dwells not so much upon the diversion of taxes from the federal treasury as upon the encouragement of unproductive and extravagant public expenditure. Although we are fully mindful of the contribution of some of these state and municipal expenditures toward maintaining activity in the construction industry, we share the President's concern. The prosperity of our people depends primarily upon the normal functioning of productive industry, which is the creator of public and private wealth. Government in itself is not a productive activity. It is, or should be, rather the servant of the community, including productive industry. In the well-ordered community, therefore, government seeks to promote every lawful productive enterprise, whereas the effect of the tax-exempt security has been to dry up the sources from which industry derives its life-blood. No enduring prosperity for the construction industry or for any one else will result from the dissipation of capital in unproductive public improvements while it is needed for the conduct and expansion of productive industry.

The Highways

Competition between the highways and the railways, the President seems to think, exists on an important scale, for he devoted a number of paragraphs to an emphatic statement that subsidized motor carriage should not be permitted to take profitable traffic from the railways.

The President, we fear, has been lending his ear to the old type of railroad manager who seeks his salvation in the throttling of competition rather than in improvement of his own service. It is true that the motor truck has taken business from the railroads but the President does not seem to appreciate that this traffic is largely short-haul less-than-carload business, unprofitable to the railroads. True, there is some competition for business that the railroads would like to have, but the extent of it is not yet sufficiently known to draw intelligent conclusions.

Moreover, experience with motor haulage in competition with the railways does not support, if the interpretation be reasonable, the President's contention that motor haulage would be wasteful if burdened with "its proper and proportionate share of highway construction." We presume that he means not "construction" alone but all highway charges. No motor vehicle advocate that we know of protests against the raising through vehicle taxes of the entire costs of maintenance and reconstruction; first construction is properly

chargeable to general taxes. In fact, if all of the revenue now collected upon motor vehicles were assigned to road funds, it would aggregate one-half of the total annual expenditure for highway work. The federal excise and other personal property taxes on motor vehicles, however, go into the general treasuries. True, motor vehicle transport bills are higher than railroad freight bills, as the President intimates, but in his easy generalization, he fails to take cognizance of the transfer charges at both ends of rail haul and to place any valuation upon the saving in delivery time.

Of course, it would be too much to expect that in four paragraphs the President could take cognizance of all the factors entering into the relationship of highway and rail transport. But four paragraphs is plenty long enough to permit the enunciation of unsound doctrine—and of that opportunity the President has taken advantage. We think the Congress would proceed detrimentally to the public interest by incorporating in its highway legislation any provisions based on the President's generalizations. Unintelligent curbing of a new agency of public service will prevent it from finding its proper place in the economic system.

The Engineer's Industrial Opportunity

IN HIS valedictory as president of the American Society of Mechanical Engineers, Dean Kimball presented an exceptionally sane and helpful estimate of the engineer's opportunity in the industrial world. One of his ideas embodies in considerable measure the essence of that opportunity. He referred to the new industrial day in which industry is coming more and more to be viewed as humanity in the act of earning a living rather than as a mechanism set up primarily for the production of profits. This conception of business enterprise is, of course, not new. The development that has prompted Dean Kimball's reference to it at this particular juncture is the growing conviction on the part of the general public that this is the proper conception and the only conception for which public opinion should be sponsor. Its special significance to the engineer is that, quite aside from his technical relation to industry, he is in position to help materially in spreading throughout business generally a faith in this fundamental doctrine.

As has been said, the idea of service before profits is not new or revolutionary. For a long time it has dominated the business policies of the shrewdest and most farsighted of our industrial and commercial leaders. It is not a conception of idealism; neither is it *wholly* a counsel of altruism. Rather is it the expression of enlightened self-interest as opposed to blind selfishness. Operating under the complex competitive conditions of modern community life; serving a public of rising standards, of increasing discrimination and of more insistent determination to have what it wants, he prospers most who serves most faithfully. Every business, of course, must render some service if it is to survive, but one will do this grudgingly, its eyes fixed on profits, while another will earn its profits incidentally, its eyes fixed on the service it seeks to render. The first type has had its day and it is nearly spent. The new day will have need and sufferance for the second only. Now this attitude toward an occupation partakes in its essence of the professional, and if the industrial world is to realize the new ideals it has set up for itself most quickly and with minimum disturbance, the professional idea of "service first, then profits" must be sold to American industry just as soon and as universally as is possible.

Provided the engineer can make good the deficiencies mentioned by Dean Kimball there is no reason why he should not be the ideal salesman for this task. He is imbued with the professional instinct, yet he is so close to the administrative problems of industry that he should be able to speak and understand the language of the business man. His analytical skill is equal to that of the lawyer or the economist, yet he is dominated by the constructive instinct as is neither of these. His viewpoint is that of a conservative, respecting that which has proved its worth; tempered, however, by the spirit of the pioneer, ever seeking to adapt to the service of the community the newest of scientific discovery. In every respect the engineer is qualified to undertake the mission of spreading the professional spirit in industry—provided that he will perfect his understanding of economic principles and develop his sympathy with human problems.

Even with the best of intentions, not every engineer will be able to measure up to these requirements. But as Dean Kimball points out, the new day is opening up broader opportunities to those of the profession who are equipped to undertake this task; and if they are to be ready when they are wanted the time to prepare is now.

Sewage-Works Progress at Chicago

THE magnitude and variety of the sewage-works program of the Chicago Sanitary District and its significance to sewage-works engineers and to cities throughout the country is not generally recognized. The seven major projects, so far as yet planned, include activated-sludge plants equipped with a variety of dewatering devices that will provide valuable working-scale data. These data, like so many already gathered by the engineers and chemists of the Sanitary District, promise to be widely useful. Besides Dorr thickeners for use in the settling tanks, following activation, there are in use or will be used on the sludge, at one plant or another, an Oliver vacuum sludge filter, a Berrigan platen press and a Besco-ter-Meer centrifuge for the preliminary, and an Atlas drier for the final, dewatering stage. Both Imhoff tanks and fine screens of the Riensch-Wurl type will throw light on preliminary treatment to lighten the burden on the activated-sludge process.

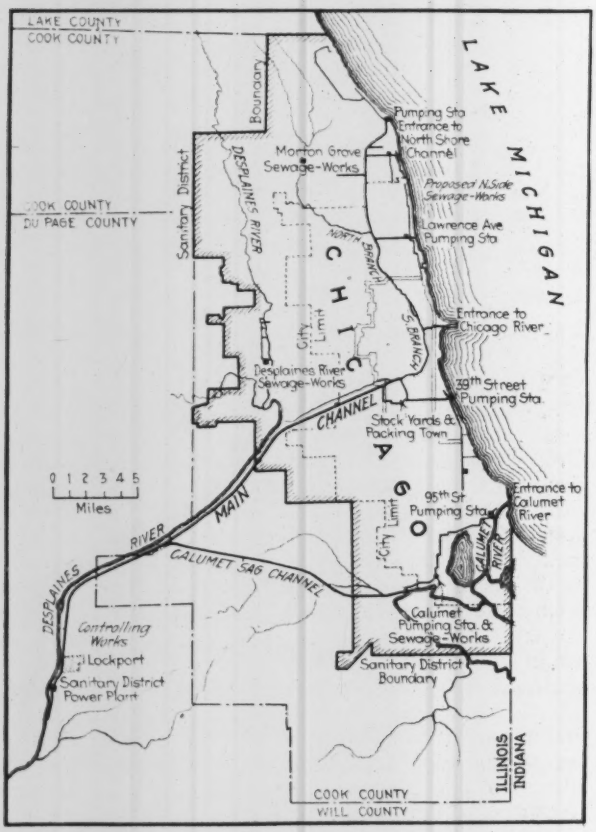
Some of the plants will deal with such troublesome industrial wastes as those from the stockyards and packingtown, from tanneries and from corn product's manufacturing operations. Parts of the program look ahead to a possible large central sludge dewatering plant for the recovery of fertilizing values, and the pumping of sludge from perhaps two or more activated-sludge plants through long pipe lines to the dewatering plant. Besides all this, the various pumping plants include some unique electric-driven pumps that cannot fail to be interesting and suggestive to many engineers, now that sewage pumping is becoming relatively common and electric motive power gaining in favor. From all this it appears that the dozen years to come, like those just past, will see much of interest and value to sewage-works engineers coming from the engineering offices, laboratories, testing plants and sewage-works of the Sanitary District of Chicago.

Sewage-Treatment Progress in Chicago Sanitary District

Program Includes Seven Major Projects — Changes Since Earlier Articles, Sludge-Handling Equipment and Early Operating Experiences Described

By Langdon Pearse
Sanitary Engineer, Sanitary District of Chicago

TWO new large sewage-works have recently been put into service by the Sanitary District of Chicago. A third has been in operation for several years. Each one of these stations is supplied by electrically-driven pumping stations of novel design. In addition a fourth sewage pumping station is operated by float switches with a minimum of attendants. One of the large pumping stations and a future station are to be supplied by emergency power from generators driven by Diesel engines. In the smaller pumping stations the pumps handle the sewage without the use of screens. The engineering details of the Calumet, Evanston and Des Plaines pumping stations, together with the general details of the Des Plaines activated-sludge plant and the Calumet treatment works were described in the *Engineering News-Record* as noted in detail later on.



CHICAGO SANITARY DISTRICT BOUNDARY AND WORKS

The district now has an area of 439.5 sq.mi., of which 199.4 comprise the City of Chicago and 240.1 cover the whole or parts of 49 other minor civil divisions in Cook County. The district was created to divert the sewage of Chicago and adjacent territory from Lake Michigan to the Mississippi drainage system. Under the original plan, all the sewage of the district was disposed of by dilution but due to government limits set on the amount of water diverted from the lake and to other causes a treatment program is being carried out. The main and branch channels, pumping stations, existing sewage-works and some of the projected sewage-works are shown on the map.

SEWAGE-WORKS OF THE SANITARY DISTRICT OF CHICAGO

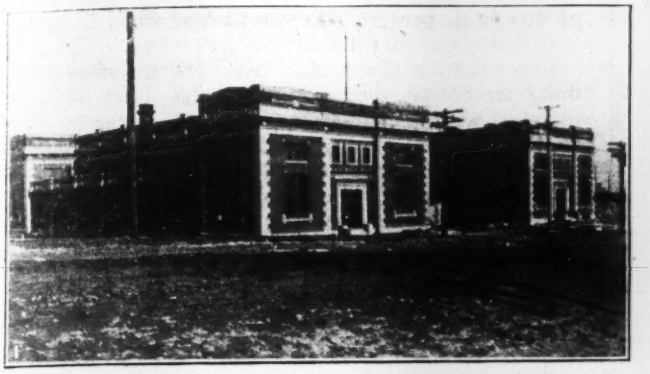
Works	Population Served 1922	Population Served 1930	Date in Service	Type of Plant
Morton Grove	1,127	.....	Dec. 9, 1914	Imhoff tanks, covered sprinkling filter and secondary tank
Des Plaines River	40,000	.....	Aug. 1, 1922	1 in. 1/16 in. x 2 in. screens; grit chamber activated sludge
Calumet	150,000	225,000	Sept. 22, 1922	1 in. screen, grit, Imhoff
Glenview	.....	868	Plans completed	Imhoff tank, sprinkling filter, and secondary tank
North Side	.....	800,000	Plans under way	Activated sludge
West Side	.....	1,430,000	Future	Activated sludge
Southwest	.....	1,230,000	Distant future	

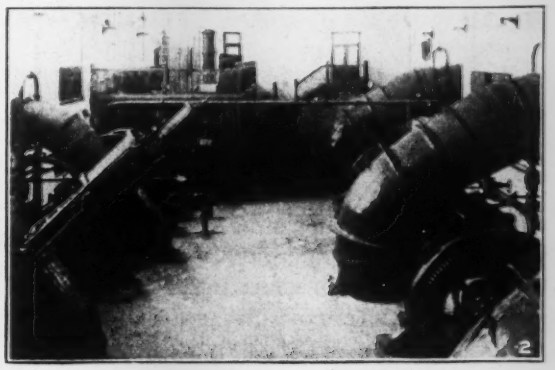
* One unit sprinkling filter (0.74 acre) and two activated sludge units each handling 1.75 m.g.d.

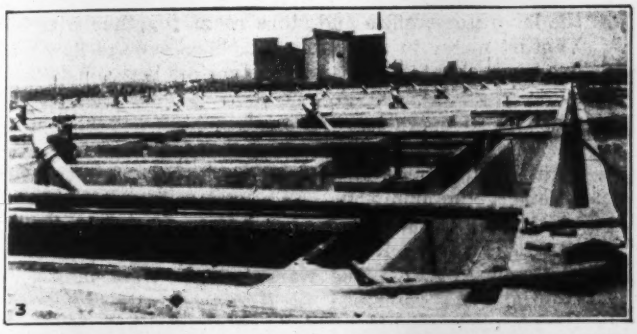
All of these plants are now in operation. It is the purpose of this article to bring information regarding these plants to date with illustrations, noting changes made and such results as have been obtained.

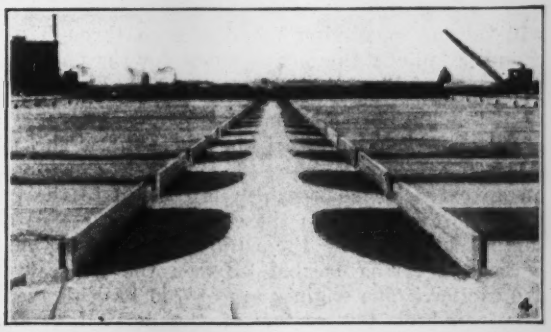
In the sewage-treatment program since 1909, two distinct lines of investigation have been followed, one on domestic sewage, the other on industrial wastes. The importance of the industrial load has been shown by gagings and tests of late years which indicate that the industrial wastes from Packingtown and the corn products and tanning plants are equivalent to wastes from more than 1,500,000 people. The domestic sewage was studied from October, 1909, to January, 1915, in a testing station at the 39th St. pumping plant (see *Engineering News*, March 31, 1910, p. 367). The results have not been published. A testing station operated on the mixed wastes from Packingtown from September, 1912, to September, 1918, indicated that screening followed by the activated-sludge process was the most practicable method of treatment. On the tanning industry wastes, tests have been run on the effluents from a large chrome tannery from December, 1919, to December, 1922. This station will be shut down before the end of 1922. On the corn products industry wastes, tests have been run in co-operation with the Corn Products Refining Company, at Argo, from April, 1921, which will probably be continued until the summer of 1923. Both the Des Plaines River and Calumet sewage-works include experimental features on a considerable scale to aid in planning the larger work ahead.

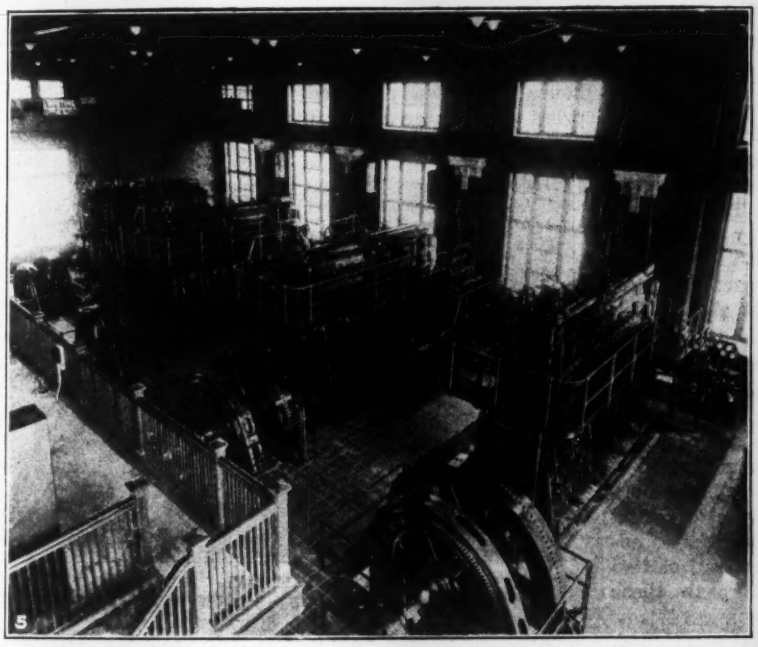
As the engineering studies developed, the division of the Sanitary District into seven major projects became evident. These are the Calumet, handling the sewage south of 87th St.; North Side, from the north line of the Sanitary District to Fullerton Ave., in the city of Chicago; West Side, Fullerton Ave. south to the Main Channel and west to Harlem Ave.; Southwest, from the Main Channel south to 87th St.; Packingtown, handling locally the industrial wastes from the packinghouses and stockyards in that locality; Corn Products, handling locally the wastes from the Argo factory; and the Des Plaines River works, dealing with the sewage from a group of seven villages on the Des Plaines River north of Riverside. In addition to these major

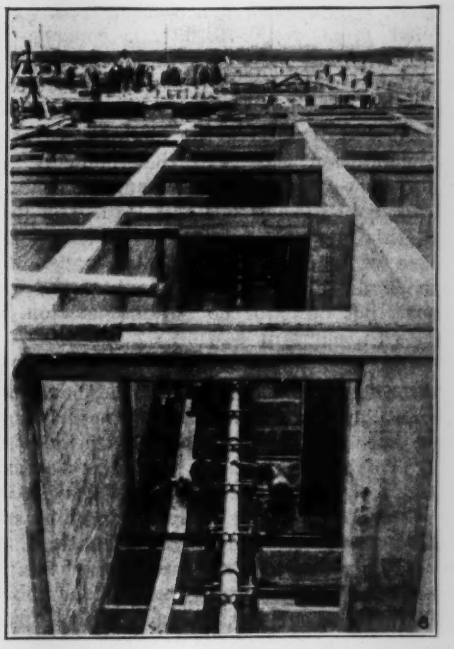












CALUMET SEWAGE-WORKS AND PUMPING STATION FOR THE SANITARY DISTRICT OF CHICAGO

(1) General view of pumping station. (2) Interior of pumping station. On left 75 sec.-ft. units, vacuum pumps and switchboard. On right 275 sec.-ft. units. (3) Imhoff tanks showing air-lift and sludge piping. Effluent channel at left. (4) Sludge-drying beds. (5) Activated-sludge unit showing piping and ridge-and-valley bottom built inside of Imhoff tank walls. (6) Four 750-hp. stand-by Diesel engines direct-connected to 625-kva. generators. Switchboard on the left.

projects isolated plants have been considered, from time to time, for outlying villages where intercepting sewers would be too expensive at present, plants for single communities or for two or more towns. So far only one small plant has been built, namely for Morton Grove. The intercepting sewer systems and pumping stations have been planned to feed the works suggested.

Calumet Pumping Station—The Calumet pumping station has been in operation since Aug. 1. The changes from the previous description (*Engineering News-Record*, Nov. 4, 1920, p. 872) have been in the rack cleaners, in that the motor runs continuously in one direction, the speed being reduced by gearing and a mechanical reversing device provided for the reversing of the rakes. The pumps prime and work successfully, but have not as yet been closely tested. The final tests

DES PLAINES RIVER ACTIVATED-SLUDGE PLANT
Screen house, blower and pump house at rear. Aerating tanks in middle distance, with pipe gallery next and settling tanks at front.

will involve measuring the discharge through a weir chamber built in the outfall sewer for the purpose.

In the building adjoining the pumping station, connected by an underground passage, are located four 625-kva. Diesel-engine-driven generators. The generators, flywheel and 16-kw. 125-volt exciter are mounted on an extension shaft which is coupled to the engine crankshaft just within the engine frame. This shafting is supported by the engine end bearing and an outboard bearing located between the generator and the exciter. The engines are of 750 brake-horsepower —operated at 180 r.p.m.—of the vertical two-stroke cycle, single acting, crosshead type. Fuel oil is supplied from four 10,000-gal. concrete storage tanks located underground between the two buildings. Raw water taken from the storm-water relief conduit leading to the Calumet River is used for condensing purposes. On tests the engines operated with a fuel consumption less than the following guarantees per horsepower-hour: Full load, 0.47 lb., three-quarter load, 0.49 lb. and one-half load, 0.53 lb. The purpose of this power plant is to furnish standby service in case of a breakdown of the transmission line from the hydro-electric power plant of the district at Lockport, not only to the Calumet station but also to the 95th St. pumping station 7 miles away.

Calumet Works—The Calumet sewage-works, which went into operation Sept. 11, have been built substantially as described in *Engineering News-Record* of June 9, 1921, p. 986. They include Imhoff tanks (convertible into aeration tanks) with sludge-drying beds; two activated-sludge units, with Dorr thickeners in the settling tanks; a sprinkling filter unit with dosing tanks and secondary settling basins. One activated-sludge unit and the sprinkling filter treat settled sewage. The present population tributary to these works is about 150,000.

Since the date of the previous article, just mentioned, bar screens inclined at 45 deg., with 1-in. clear openings, and grit chambers with five passages, have been provided. They are to be equipped with a gantry crane spanning the chambers to hoist buckets containing the grit. In a building housing the pumps and blowers are located electrically-driven pumps which discharge through a Venturi-meter rate controller which can be set automatically to deliver a given amount of settled sewage to the sprinkling filter unit. In addition there will be installed four blowers of the hydro-turbine type to operate against a pressure of 8 lb. per square inch. Two of the blowers will have a capacity of 2,500 cu.ft. per minute each, one of 1,000 and one of 450 cu.ft. per minute. These blowers will be electrically driven by silent chains.

For handling the sludge from the activated-sludge units an Oliver vacuum type sludge filter is to be installed with a cylinder 11½ ft. in diameter by 14-ft. width of face and approximately 495 sq.ft. of filter surface. A centrifuge of the Besco-ter-meer type may also be installed in the same house, together with a 4 x 30-ft. Atlas dryer having a guaranteed evaporation capacity of 2,000 lb. per hour. The intention is to try the centrifuge in the winter on Imhoff sludge as well as on activated sludge to determine its capacity and relative economy as compared with drying the sludge on beds and its subsequent removal by hand.

An administration building is also provided, housing the laboratory, office and store room, together with the Venturi meter in the basement. The sewage flow now averages about 30 sec.-ft., fluctuating between 27 and 37 in dry weather. At the present time one-half the plant is in operation. The other half will be put in operation as soon as the dry-flow sewage from the 95th St. pumping station area can be turned in through an emergency pump.

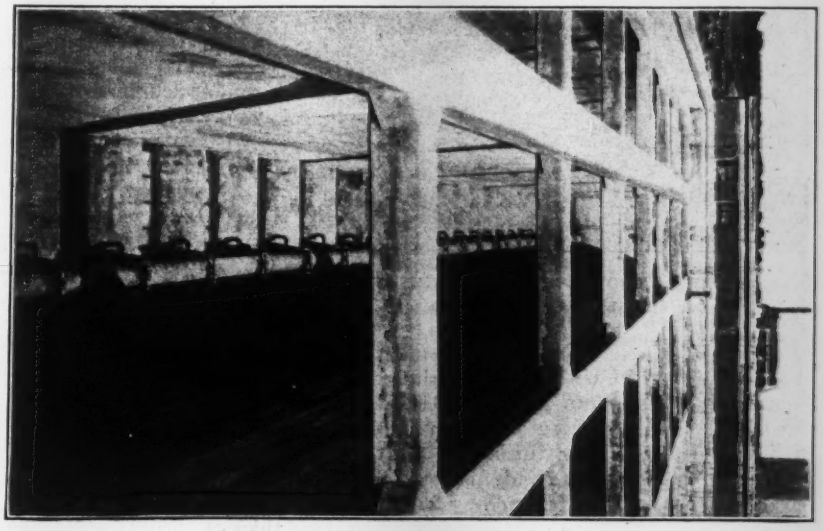
Des Plaines River Works—After many vicissitudes the Des Plaines River sewage-works went into operation on Aug. 1. The works proper were built substantially as described in *Engineering News-Record* Dec. 9, 1920, p. 1134. This is an activated-sludge plant, with coarse rack screens, a grit chamber, a Riensch-Wurl screen. Some of the settling tanks are fitted with Dorr thickeners. In addition, a press-and-dry house has been provided, including a Simplex plate press with center feed, containing 120 plates each 36 in.

VERTICAL-SHAFT CENTRIFUGAL UNITS OF THRASH-PUMP TYPE, DES PLAINES PLANT

square, chambered to make a 1-in. cake; a Berrigan platen press containing 18 bags working between leaves 6 ft. wide and 8 ft. deep and a centrifuge of the Besco-ter-meer type, not yet erected. The sludge cake will be lifted to the second floor in specially designed buckets. In the basement of the press-and-dry house are arranged two pneumatic ejectors, a centrifugal pump and a stuff pump electrically-driven, each of which may be used to feed sludge to the presses or to the centrifuge. The purpose is to determine whether or not there is any different behavior of the sludge after being handled by such pumps. In the press-and-dry house there is also installed a 4 x 30-ft. Atlas dryer, together

with a screen and a bucket elevator to raise the dried sludge from the first to the second floor. The dryer is fired by an automatic stoker. The sludge is fed to the dryer on the second floor. The apparatus is designed to take wet press cake and mix it with a given amount of dried material so that the material entering the dryer can be maintained at any given degree of moisture. The dryer went into operation early in October. Storage is provided on the second floor of the press-and-dry house for press cake, and also for a limited amount of dried material. It is proposed to operate the dryer continuously for two or three days each week to determine its capacity and behavior and to run the sludge presses as continuously as possible. Arrangements are provided for acidifying and heating the raw sludge.

The dry flow of sewage has varied from 3 to 3½ m.g.d. During storms more than 10 m.g.d. have passed through the fine screen, of which 4 m.g.d. were handled in the plant. The suspended matter in the raw sewage when the plant was first started averaged 200 p.p.m. Following an exceptionally heavy storm, which flushed out the flat sewers tributary, the suspended matter ran as high as 2,000 p.p.m. for a day. The screenings on the ⅛ x 2-in. slots of the 14-ft. diameter Riensch-Wurl screen have averaged 200 lb. per day, wet, but following the storm more than 2,000 lb. were removed in one day. Occasional applications of kerosene have been found necessary to keep the slots free from grease. So far little grit has been obtained.



AERATION TANK AT DES PLAINES PLANT
Tank 15 ft. deep with ridge-and-valley bottom. Pipe gallery in background.

In the aeration tanks the sludge built up more rapidly than could be cared for, so that over 40 per cent of sludge was accumulated before pressing began. Consequently a higher rate of air has been used than will probably be necessary later on. From 1½ to 2 cu.ft. of air per gallon of sewage have been used. The filtros plates have given an even distribution. The settling basins of the hopper-bottom type with slopes 2 vertical to 1 horizontal have shown need of some scraping. It is evident that the 2 on 1 slope is not quite steep enough on a large working scale to permit the sludge to slide rapidly to the bottom. The Dorr thickeners have worked well so far. The air lifts are being adjusted.

In the sludge handling the intention is to run the presses as continuously as possible and to make sludge cake. From time to time runs will be made with the dryer and enough sludge accumulated and bagged to supply experiment station work during the coming year. The nitrogen content of the sludge, as shown by one or two analyses, started low, averaging 2½ per cent on a dry basis. This low fertilizer value is probably due to the clay discharged by the flushing of the sewers during storms. It is now more than 3½ per cent.

Although the sewage reaching the plant was at the start very stale and devoid of dissolved oxygen, the plant has been remarkably free from odors.

Morton Grove Works—The Morton Grove plant discharges the effluent into the North Branch of the Chicago River. The plant is located directly across the street from a busy roadhouse, so that an unusual endeavor was made to design a system which would be free from odor. The Imhoff tanks and sludge beds were built in 1917. In 1920 there were added two covered sprinkling filter beds, each 36 x 36 ft. in plan, filled with 1½- to 2-in. crushed limestone to an average depth of 6.2 ft. The beds are dosed by float-operated centrifugal pumps discharging through a system of pipes which distribute the sewage over the surface of the beds through nozzles and splash plates. Overhead distribution was adopted so that in case the pumps stopped in cold weather the pipe system would drain automatically. Two centrifugal pumps are housed alongside the filter, each capable of delivering 125 gal. per minute when running at 1,200 r.p.m. They are float-operated with single-phase motors and automatic oiling. As the splashing of sewage from the nozzles penetrated the brick walls of the building, the inside face of the walls was plastered during this last summer to prevent further moisture travel, two coats of hard waterproofing plaster being used. The dry-weather sewage flow has been from 125 to 250 gal. per minute, according to the amount of ground water. Practically no trouble has been experienced from odors.

A plant very similar in design has been prepared for a population of 800 people at Glenview. A tank-and-sprinkling-filter plant has been chosen again on account of the lower cost of electric power for pumping as against the activated-sludge type with the combined cost of air compressing and pumping. The Glenview plant, however, will have an open sprinkling filter as the location is more remote from habitation. The sludge will be removed from the tanks by an airlift, instead of a centrifugal pump, as at Morton Grove.

Evanston Sewage Pumping Station—The Evanston sewage pumping station (*Engineering News-Record* Nov. 4, 1920, p. 872) has been in operation for more than two years. No changes have been made in it except to install an automatic oiling system on the pump steady bearings. Very little difficulty has been experienced with the operation of the trashpumps without screens. During the first few months of operation occasionally 2 x 4- and 2 x 6-in. sticks passed into the run-

ners and stopped the pumps, but they were readily removed. With the completion of the construction work on the tributary system, no further difficulty with timbers has been experienced. At infrequent intervals, however, some floating trash has to be removed from the suction chamber.

Tannery Testing Station—The tannery testing station is located alongside the Griess-Pfleger Tanning Co., in Chicago. This is a large chrome tannery with five sewer outlets. The testing station has been operated from the start with activated sludge, but different preparatory treatments have been tried. Included in the installation have been a fine screen, with holes 0.1 in. in diameter, a Dorr thickener, 19 ft. 10 in. in internal diameter by 7½ ft. deep, four activated-sludge aeration tanks, each 6 ft. wide by 23 ft. long by 11 ft. water depth on the filtration plates with a Dorr thickener for final clarification, 11½ ft. in diameter by 11.4 ft. deep. The various mixtures of tan, beam and soak liquors have been tested, as well as the need of thorough treatment preparatory to aeration. At first the aeration tanks were fed only during the working hours, but since last winter storage has provided a continuous flow. A sprinkling filter, 14 ft. square and 6½ ft. deep, has been operated on settled mixtures, together with cinder beds and sand beds. Great care has been required in operation to avoid caustic alkalinity, which injures the activated sludge. The activated-sludge process has been difficult to control, especially in cold weather. With continuous feeding a period of 12 to 15 hours and air in amount 2.5 to 3.5 cu.ft. per gallon has been used. In summer nitrates may run up to 30 p.p.m. The sprinkling filter has been dosed at a rate of 1 m.g.d. per acre, producing nitrates from 10 to 20 p.p.m. The cinder filter has worked at rates of 300,000 m.g.d. per acre and removes color. Nitrates have run from 20 to 30 p.p.m. All the devices have been supplied with a settled mixture of the three tannery wastes, the suspended matter being reduced from 1,000 to around 350 p.p.m. by the Dorr thickener.

MORTON GROVE SEWAGE-WORKS, CHICAGO

Imhoff tank and sludge-drying beds at left. The building covers splash-plate sprinkling filters. Secondary settling tanks in foreground.

Corn Products Testing Station—The testing station at Argo is being operated jointly by the Corn Products Refining Co., J. J. Merrill, chief engineer, and the Sanitary District. Prof. Edward Bartow is consultant for the company. With the exception of a sprinkling filter 14 ft. square and 8 ft. deep, this station has been operated on activated sludge. At present the installation includes (1) two standard aeration tanks, each 6 ft. wide by 23 ft. long by 12 ft. deep, with a 12-ft. diameter Dorr thickener settling tank, which has been run on a 13-hour period with air from 4.5 to 5.0 cu.ft. per gallon; (2) a circulating tank 6 ft. wide by 23 ft. long by 12 ft. deep, with a settling tank 6 ft. square by 12 ft. deep, baffled like an Imhoff tank, which has run on a 13- to 15-hour period, with air from 3.5 to 3.8 cu.ft. per gallon; (3) two Manchester type tanks, each 8 ft. wide by 23 ft. long by 12 ft. deep, with a 12-ft. diameter, Dorr thickener settling tank, which has been run on a 13- to 15-hour period, with air from 3.4 to 3.5 cu.ft. per gallon. The Manchester type of bottom has shown a better effluent than the others, with less air per gallon. The ratio of filter-plate area to total area has been 1 to 13, as against 1 to 11.5 in the circulating tank and 1 to 5.75 in the standard tank. Tests have been made on sludge pressing, using a plate press and also an American rotary vacuum filter. This work is still in progress. In the original installation two Dorr-Peck double-deck activated-sludge units were included. The results obtained were no better than the standard tank and at times not so good. The use of these tanks was abandoned last winter (see *Engineering News-Record*, Feb. 9, 1922, p. 251).

Future Works—At the present time the engineering staff has practically completed the plans for the new 95th St. pumping station of 750 sec.-ft. capacity in the Calumet district which will be tributary to the Calumet sewage-works. This pumping station will contain three 72-in. pumps and two 30-in. pumps and will be somewhat similar in general design to the Calumet station. It will be electrically driven from Lockport but in emergencies can be operated from the Calumet power plant.

Since the report was made by the engineering commission composed of Messrs. Eddy, Fuller and Hatton (see *Engineering News-Record*, Aug. 24, 1922, p. 324) work has been pushed actively on the design of the North Side treatment works with the result that the plans for the activated-sludge tanks are nearly completed. The details of the power plant, screens and the like have not as yet been completed. In accordance with the recommendation of the engineering commission, the sludge is to be pumped 18 miles to waste land owned by the district and lagooned. This site is in the vicinity of the proposed West Side plant. With the experience in hand of the Des Plaines River and the Calumet Works in handling sludge, the preparation of the sludge from the North Side and West Side will be approached later on.

Illinois River Survey—Twenty years after the opening of the Main Drainage Canal it seemed fitting that an extended investigation should be made of the condition of the flow from Chicago to the Mississippi River over a period of a year. This met the desire of the United States Public Health Service to obtain data to supplement the Ohio River and the Potomac River studies. The field work of a joint survey terminated on Sept 1, and the results are now being compiled. Bacteriological data show markedly the bacterial death rate from Chicago to Peoria and bear out thoroughly the judgment of the United States Supreme Court in the case of Missouri vs. Illinois to the effect that the sewage of Chicago would not affect materially the Mississippi River above the St. Louis water-works. From the data accumulated it is hoped to compile some re-aeration factors and to determine to what extent dilution and

reaeration are responsible for the remarkable self-purification which goes on in the Illinois River.

The work described has been carried on under the general direction of H. P. Ramey, acting chief engineer of the Sanitary District of Chicago, who succeeded A. W. Dilling, chief engineer, upon his retirement in July. The work was begun under George M. Wisner and continued by E. J. Kelly, Mr. Dilling's predecessor. The engineering staff working on the developments include the writer, sanitary engineer; Julius R. Hall, principal assistant engineer; S. Moreell, Jr., structural engineer; L. C. Whittemore, assistant sanitary engineer; I. P. Kane and O. L. Eltinge, assistant engineers; H. I. Steffa, mechanical engineer; I. T. Roberts, electrical engineer; and F. W. Mohlman, chemist. A. B. Wood of New Orleans, La., has been the consulting engineer on the pump layouts. In the co-operative work the United States Public Health Service has been represented by Surgeon W. H. Frost in charge and J. K. Hoskins, sanitary engineer.

The Engineer and the Demand for Industrial Leaders

Dean Kimball, Retiring President of the A.S.M.E., Weighs Qualifications of Engineer for Industrial Management

By Dexter S. Kimball
Dean, College of Engineering, Cornell University

Extracts from address as retiring president, A.S.M.E., delivered at Annual Meeting, New York, Dec. 4, 1922.

THE benefits that have accrued to all classes in modern civilization are beyond question and are more apparent when comparison is made either with older forms of civilization, or even with existing handicraft nations. The general level of physical comfort and education as seen in modern nations is unquestionably higher than has ever before been attained. Nevertheless, no single class of people is satisfied with its position in the nation, and there is a deep feeling of unrest and discontent among those workers who actually produce the comforts of life.

This charge that modern civilization is a failure or at least no improvement upon former civilizations, is or should be of peculiar interest to the engineer, using this term in its widest sense to include all industrial workers who use the scientific method. For modern civilization is largely what he has made it, and the civilization of the future will be largely what he wishes it to be. It is too much, of course, to claim that the engineer, unaided, can solve these difficult problems, but it is undoubtedly true that if he will direct his energies to the problem of the distribution of wealth as earnestly as he has devoted them to its production, he can make a contribution to industrial economics that will be exceedingly helpful. The engineer alone has a direct and personal knowledge of the industrial machine.

Furthermore, it should be noted that the efforts of the engineer are no longer confined to the design and actual production of commodities. The principles of mass production that have so greatly reduced the cost of commodities he has now quite fully developed. The wide application of the principles of mass production has been made possible by mass financing, the work of the financier. The engineer, in turn, is now developing the principles of mass management, and his contributions to the philosophy of management are already noteworthy. I believe most business men would be surprised to know to what a large extent the methods of the engineer have invaded their chosen field, and there can be little doubt but that the near future will see the engineering type of manager a predominant figure.

It will be freely conceded that the preparation of the engineer for these new duties is far from adequate, and two of his shortcomings stand out conspicuously. The first is his lack of knowledge of the economic principles of industry and commerce. This need in the equipment of the engineer is now fully recognized, and in a fair way to be remedied. All first-class engineering colleges now prescribe more or less economic study and students of engineering recognize this study as a necessary part of their mental equipment.

Another important weakness in the mental processes of the engineer is his lack of knowledge of human nature and, worse still, his lack of sympathy with human problems. He is by nature a constructive individualist and usually impatient to obtain results; and, as a consequence, impatient of any obstruction, human or physical, that stands in the way.

Over against these weaknesses must be placed certain inherent qualities that strengthen his claim to industrial leadership. He is, as a class, essentially honest. His entire training and professional experience are such as to demand honesty of thought and purpose in all of his transactions.

The engineer also often occupies a strategic position in industry which is of great importance in controversial matters. As the designer and planner of industrial enterprises he stands between capital and labor, and he is, not infrequently, better informed of the real difficulties at issue.

And last, but most important, the engineer has command of the scientific method of attacking problems. With this he has practically solved the problem of production and is now rapidly rebuilding the field of administration. Is it reasonable to suppose that he cannot make a great contribution to the problem of the distribution of wealth if he attacks this problem in the same wholehearted manner?

Need for New Leadership — Thinking men who know industry agree that we should have a new form of industrial leadership, but the source of this new leadership does not seem to be clear. And it should be noted that future industrial leadership will be closely associated with political leadership, so closely are the problems of industry linked with political administration. The first form of national leadership was the military type, the rule of the strong man. This extreme form of leadership still prevails in some countries. In modern democracies military rule has been succeeded by what may be termed legal government. Today our social, political and industrial activities are governed by a very comprehensive code of legal regulations that rest upon precedent and upon the opinions of eminent jurists sometimes affirmed and reaffirmed many times. The legal method and the legal mind, however, are for the most part backward looking in their processes.

There remain for consideration two other types of mind from which a new industrial leadership may come; namely, the business or financial type, and the scientific type. The business type of mind with the aid and counsel of the legal and engineering fraternities has built up modern industry as we now see it. There can be little doubt as to the ability of this type of mind to plan and direct the larger aspects of industry along existing lines. One weakness lies in its apparent inability to appreciate or rather to acknowledge that a new industrial day has dawned in which industry is being viewed more and more as the support of human life and not as a means of producing private, corporate, or state profits. Another weakness is its lack of technical knowledge of modern industry. As industry becomes more and more complex, the business man is compelled to depend more and more upon the engineer for advice and knowledge. It is this very phase of modern industry that is rapidly forcing the rôle of industrial manager upon the engineer.

No one would presume to say that the engineer alone can solve the industrial riddle, but it is clear that he can make a very great contribution to the solution. But it becomes increasingly clear that hope of a solution rests with the two groups just discussed. The National Department of Education has for some time been advocating strongly that engineering students be taught more of the fundamentals of business and that young men preparing for the field of business and commerce be instructed in some of the outstanding features of engineering. And it may be that we shall yet develop a combination of these two fields that will produce the new type of industrial leader.

Building the North Platte Branch; Union Pacific R. R.

Tracklaying Train Has Locomotive Crane to Place Rails—Small Station Layouts—Line Serves Irrigated District

AN IMPORTANT railway extension built in 1921-1922 is the North Platte branch of the Union Pacific R.R., which is a land development or settlement project, progress on which was interrupted by the World War. It is a continuation of a line, which, starting at O'Fallons, Neb., follows up the North Platte river 152 miles to Haig, Neb. This point was reached in 1914. The new 42-mile extension, running westward from the river, as shown in Fig. 1, was commenced in 1921 in order to provide railway transportation for a 50,000-acre district which had been put under irrigation by the U. S. Reclamation Service. For convenience of construction and accounting the line was divided into three sections; 14 miles west to the Nebraska-Wyoming state line, 15 miles west to Cherry Creek and then 13 miles north and eastward down the valley of that creek.

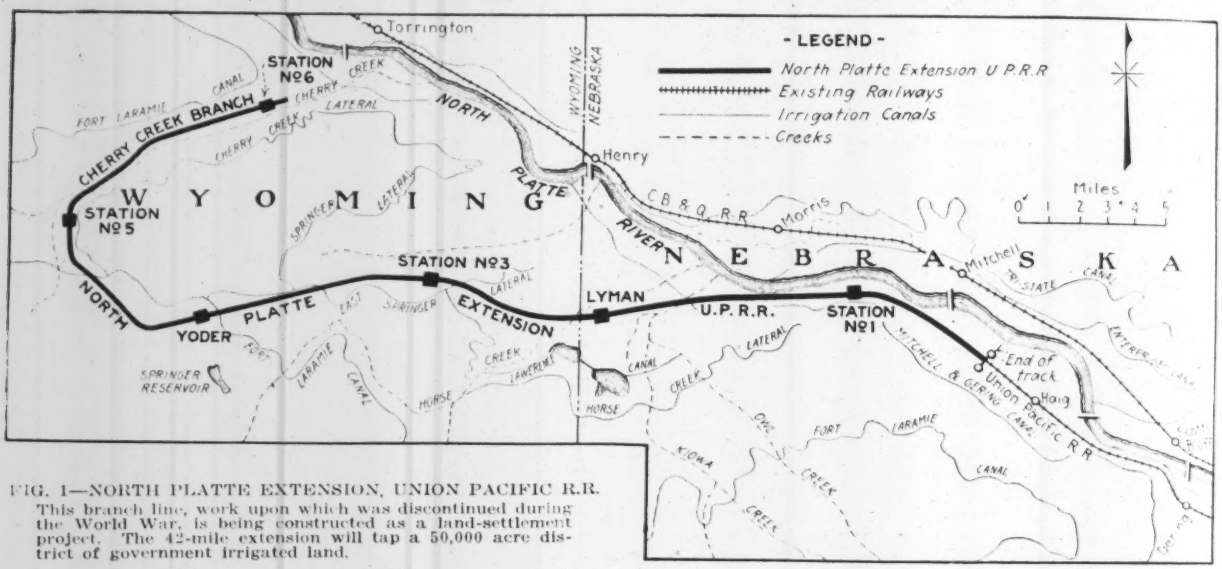


FIG. 1—NORTH PLATTE EXTENSION, UNION PACIFIC R.R. This branch line, work upon which was discontinued during the World War, is being constructed as a land-settlement project. The 42-mile extension will tap a 50,000 acre district of government irrigated land.

Grading and Structures—The line is in the rolling prairie country of a semi-arid region and has maximum grades of 0.6 per cent in both directions. Its sharpest curves are of 3 deg. Elevations above sea level are 3,926 ft. at Haig; 4,250 ft. at Yoder, 27 miles farther on; and 4,155 ft. at Station No. 6 (the present end of the line). Earthwork averages 27,000 cu.yd. per mile and is largely clay and loam, but with some solid rock. Excavating machinery includes four steam shovels, six elevating graders and a number of fresno scrapers with teams. Material for fills is 47 per cent from cuts and 53 per cent from borrow pits. Temporary trestles for dump-car trains were used in making the heaviest fills, the haul being about ½-mile and the 4-yd. cars being dumped by hand. The remainder of the fills were built with dump wagons and scrapers.

Four through girder bridges with spans of 50 to 110 ft. on concrete substructures are required for irrigation canals and drainage ditches. Twenty trestles averaging 55 ft. in length and 10 ft. in height are built with creosoted piles and open decks of untreated Oregon fir. Culverts and small concrete bridges average seven per mile. Stations for new town sites are frame buildings with living rooms for the station agent, as shown in Fig. 2. The typical layout of tracks and buildings at these small stations is shown in Fig. 3. Fairly good water for the engines is obtained from wells. The nearest engine terminal and repair shop is at North Platte, Neb.

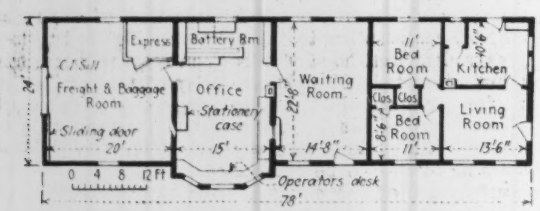


FIG. 2—COMBINED STATION AND AGENT'S HOUSE

Tracklaying Methods—In tracklaying, a locomotive crane is used. At the material yard a second crane loads rails and ties onto flat-cars for the tracklaying train, which is taken to the front by a locomotive. The crane is at the head of the train with the rail cars next, then a car of fastenings and after that the cars of ties.

On reaching the front, ties are unloaded into wagons to be hauled ahead and distributed on the grade. Eight wagons are usually employed to keep the ties distributed ahead and the force for handling ties consists of eight teamsters and thirteen laborers. The rails are taken by the crane from the cars behind it and delivered onto the ties. To handle the rails, there are three men on the cars and twelve men on the ground. Behind the train is a force of about 65 men for backspiking, lining and bolting. In addition to the above usually about twenty-five men are required in the material yard to load material.

Since the tracklaying is done intermittently, no high records have been made, but the maximum progress has been 4,400 ft. per 9-hour day with a force of about 100 men. All tracks are laid with 90-lb. rails of the Union Pacific R.R. standard section, using No. 10 frogs in main tracks and No. 9 at all other points. Both

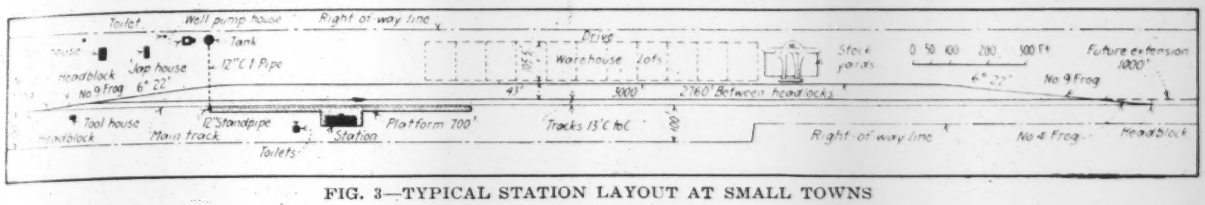


FIG. 3—TYPICAL STATION LAYOUT AT SMALL TOWNS

Oregon fir sawed ties and Wyoming pine hewed ties are used, all treated with zinc-chloride. Tracks are ballasted with cinders, averaging 1,000 cu.yd. per mile. Passing sidings 3,000 ft. long are provided at intervals of about seven miles.

Motor trucks and the contractor's trains moved supplies from the base at Haig to the head of steel. The Utah Construction Co. has the general contract for grading, bridging and tracklaying. Stations are built and water facilities provided by the railway company's forces. The field force consists of three engineering parties to look after the grading and tracklaying and a fourth or floating party which looks after the bridge and culvert work. These parties live in camps. All the work is under the supervision of R. L. Huntley, chief engineer of the Union Pacific System.

Load Curve Charts Help Save Lost Time in Construction

For One-Purpose Machines Time Principal Factor —Multi-Purpose Machines Require Maximum Adaptability

JUSTIFICATION for the continued use of high-priced construction equipment in a declining labor and machinery market has led the Omaha (Neb.) Metropolitan Utilities District to study the load curve of its heavy equipment bought at high prices. Homer V. Knouse, assistant superintendent and purchasing agent, related as follows the results of the district's experience in a paper presented recently before the Iowa Section of the American Water Works Association:

The solution of the lost-time problem is intensive operation, or an improvement of the load curve, to the end that the overhead charges may be spread over a larger number of units. Fig. 1 represents the load curve of a wheel-type trenching machine having a maximum capacity of a trench 24 in. wide by 6 ft. deep. The white areas above the line represent lengths of trench excavated and the shaded areas below show time in hours the machine was out for repairs, inspection and general oiling. The white areas below the line represent time in hours of moving from job to job. The machine should not be penalized as fully as this curve would indicate, for it is undoubtedly true that it could have increased the total amount excavated had it been possible for the pipe-laying gang to keep up with it. This fact was noticeable where short lines were laid, when the time required for the connection was great in proportion to the time required to lay straight pipe. As a consequence the operator would spend time repairing or overhauling, which might quite as well have been devoted to digging had there been the work to do.

Fig. 2 shows performance curves used for day-to-day check on the efficiency of the machine operation. A factor or index number for the machine operator's score is obtained by dividing the sum of digging hours plus moving hours by the total hours the machine is in service, digging, moving and repairing. Idle time is not considered in this curve, inasmuch as the operator is not responsible for the time when there is no work provided for the machine. The "General Foreman's Score," checks the total time of digging, moving and repairing to total working hours and is an index of the degree to which work was provided for the machine. The third curve is a combination of the first two, and represents the value of the machine to the district. By decreasing repair time and increasing digging time, it will be possible for the operator to increase his score. Since digging time is figured by measuring the amount of trench opened and dividing by an allowance of 100 ft. per hour, it is not unreasonable to expect that a score of between 90 and 100 can be obtained by the operator. While the machine is capable of digging 138 ft. per hour, an allowance for "digging in," raising over services, cleaning buckets, oiling, greasing and adjustments, makes 100 ft. per hour for the entire day a reasonable average to expect.

The general foreman will be able, by better co-ordination of his work, to reduce the idle time and obtain a higher score. Pipe-laying gangs can be directed to follow the machine as may be necessary to keep their part of the work as closely behind the trenching machine as possible, and when numerous or difficult connections are necessary, extra gangs can be used advantageously to keep the progress at a maximum. By using this system of records the men responsible for the various factors are able to visualize the progress of their work and it is the hope that the increase in operating efficiency will decrease the unit cost of trenching for from 20 to 30 per cent.

The excavator is essentially a one-purpose machine, but in the construction department of utilities there are many operations which, although rather dissimilar, may often be performed by a single piece of equipment. A back-filler now in use by this department has had its load curve greatly benefited by adapting it to several uses. In addition to being a rapid back-filler it has been used as follows: For unloading cast-iron pipe from cars the costs were reduced 60 per cent. With bottom-dump buckets deep excavations may be handled more cheaply and the work speeded up as compared with hand methods. For erecting reinforcing steel and forms in building work the back-filler made a satisfactory traveling crane. For pouring concrete in column forms a special mast and bucket made the handling of the work a simple matter.

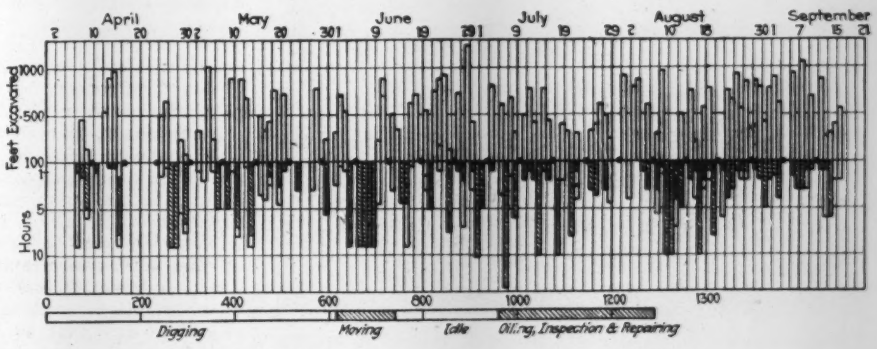


FIG. 1—YEARLY LOAD CURVE OF EXCAVATOR

The district has in service a small gasoline-driven dragline which has proved useful for excavating trenches for large size pipe, for handling pipe while laying, for unloading sand and stone, for unloading and bunkering coal and as a back-filler.

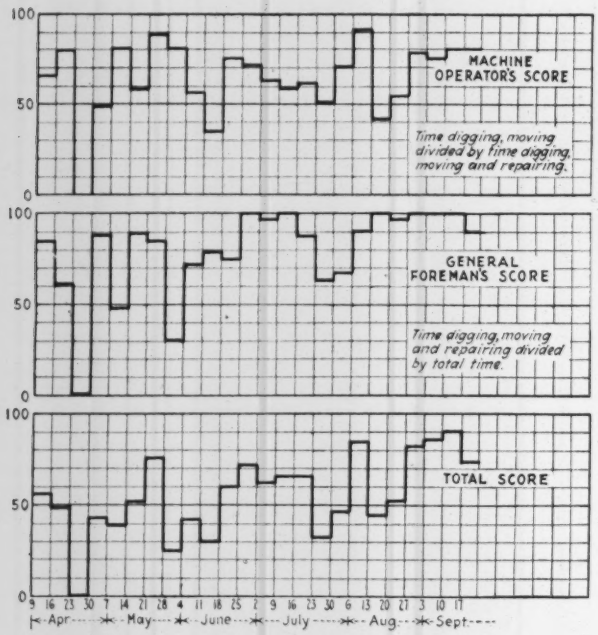

MACHINE OPERATOR'S SCORE
Time digging, moving divided by time digging, moving and repairing.
GENERAL FOREMAN'S SCORE
Time digging, moving and repairing divided by total time.
TOTAL SCORE
100
50
0
9 16 23 30 7 14 21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 3 10 17
Apr. May June July Aug. Sept.

FIG. 2—DAILY PERFORMANCE CURVES OF EXCAVATOR

An air compressor was placed in service about July 1 and while cost data are not available in sufficient detail to be published, it is felt that its purchase was a wise move.

The compressor was delivered on a steel truck, but it soon became evident that the racking due to trailing behind a truck over rough pavements would cause material damage. In consequence it was decided to mount the unit on the chassis of an old truck which had been retired from service. The first plan contemplated the use of the chassis as a trailer. As the mounting progressed, it became evident that with minor changes the unit could be propelled by the engine of the compressor. The space formerly occupied by the engine has been utilized as a tool box, and all necessary equipment can be carried to handle the various classes of work without the necessity of providing a truck to aid in moving from job to job.

The compressor has been used in connection with a paving breaker to cut paving for the installation of water and gas mains. This paving breaker is a heavy non-rotating air hammer, using 1¼-in. moil-point steel and is very effective in breaking concrete base. A chisel point tool is used for cutting and lifting sheet asphalt, or asphaltic concrete, and the moil point is used for raising brick.

FIG. 3—SPRING-CUSHIONED, RUBBER TIRED TRAILER
Ordinary steel-tired wagon limits speed, racks running gear and mixes up equipment.

FIG. 4—AIR COMPRESSOR ON OLD TRUCK CHASSIS
Engine of compressor drives the truck. The space occupied by the old engine is used as a tool box.

A foundry tamper to which was added a larger foot has been found effective in tamping re-filled material in trenches. One man with this tool is able to do the work of six men with hand tampers, and do it better.

A jackhamer drill, for use in cutting holes in walls and slabs and for the removal of old foundations, is a valuable addition to the equipment. Chipping hammers are useful in many places. When used in connection with a cement gun a large field of use is opened to the compressor. Undoubtedly many more uses will be found for the compressor as particular conditions arise, and it should be possible to get for it an attractive load curve.

The writer uses a dispatcher to order the movements of all trucks, and has found that not only is there less idle time, but that material is delivered to the job more nearly at the time it is needed. Gangs can be moved when ready and a truck is always available at some point in the city to handle emergencies.

The trailer shown in Fig. 3 was designed to make rapid transit of repair tools possible without the necessity of loading and unloading a truck whenever a move was necessary. Since this item of labor was avoided, it was possible to equip the trailer with tools to meet practically all emergencies. By the use of a spring-cushioned, rubber-tired trailer, the truck travels easily at its normal speed, whereas with the steel-tired wagon trailer, speeds of more than four or five miles per hour would soon wreck the running gear, rack the body and so mix up the contents of the wagon that tools would be damaged and rendered inaccessible.

An item of automobile expense that is generally overlooked is that of unnecessary mileage. The speed of a car makes the long way to a job seem of small importance, allows a return for forgotten tools to be made easily and makes careless routing a matter that is almost impossible to detect. Probably 15 to 25 per cent of auto mileage can be eliminated by a consideration of these items.

Summarized, the elements which should be considered when endeavoring to improve a load curve, are as follows: (1) With a one-purpose machine, it should be so designed as to give maximum hours of useful work with minimum time out for repairs. (2) Multi-purpose machines should be designed so as to be adaptable to the maximum number of uses spread as nearly over the entire year as possible. (3) Co-related work should be so organized that the equipment is able to work all possible hours. (4) Supervision should be such that duplication of trips of trucks and possible "empty" or unnecessary mileages are avoided and that no work or men are kept waiting.

Building a 6,500 Hp. Water Power Plant in New England

Work on Searsburg Development of the Deerfield River Involved Earth Dam and 4-Mile Wood Stave Pipe Line

By J. Arthur Garrod
General Superintendent, Aberthaw Construction Co., Boston, Mass.

At Searsburg, Vt., the New England Power Co., through its subsidiary, the Power Construction Co. of Worcester, Mass., recently completed another unit in its already extensive power development of the Deerfield River. The project includes a large earth dam, wood-stave conduit nearly four miles long, power house and surge tank, located on the upper reaches of the Deerfield River west of Brattleboro, Vt., and approximately ten miles above the Massachusetts state line.

Fig. 1 shows the general location of the development, also profiles, from which it will be noted that the wood-stave conduit runs from the dam with a pitch of only 25 ft. in the full length of 20,000 ft. to the power house site where the water drops 185 ft. through a steel penstock to the wheel in the power house. Where the penstock and wood-stave conduit join a concrete Y affords a connection to the steel surge tank.

The nearest railroad to the development is the Hoosac Tunnel & Wilmington R.R., which runs north from the Boston & Maine R.R. at Hoosac Tunnel, Mass., and terminates at Wilmington, Vt., about four miles from the power house site of the new development. On this railroad about two miles below Wilmington is a station called Mountain Mills, which is the headquarters of the operating division of the New England Power Co. From Mountain Mills a discontinued narrow-gage logging railroad follows the river to the site of the new development.

One of the first operations was the repair and strengthening of this narrow-gage railroad as far as the dam and its removal from the flooded area above the dam. The material yard for construction tools and supplies was, therefore, located at Mountain Mills and the materials were moved to the location over this narrow-gage railroad, or over a very good country road which also follows the course of the river, and which also had to be located outside of the flooded area above the dam.

The river valley at Searsburg is fairly narrow and the river banks are quite precipitous, in some cases approaching a 1 to 1 slope. The ground is largely clay with big boulders and nests of boulders which have apparently been old stream beds. At the site selected for the dam a ledge on the west side of the river afforded excellent opportunity for a temporary bypass and subsequent permanent intake and spillway in solid rock.

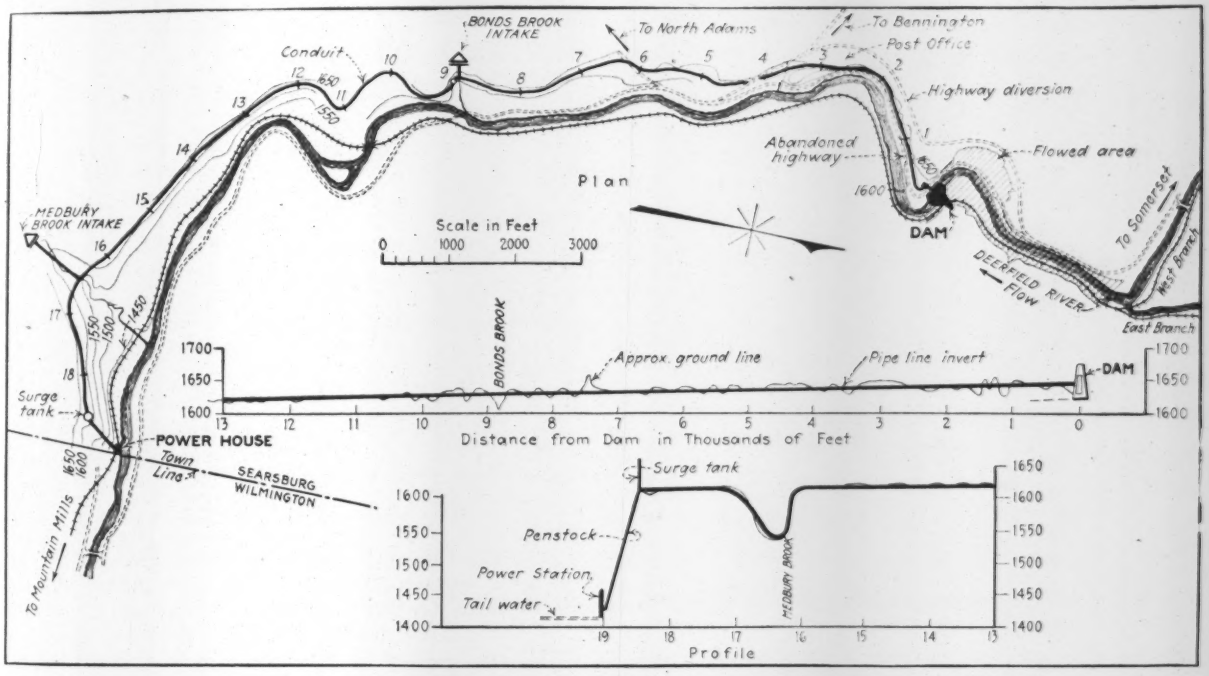
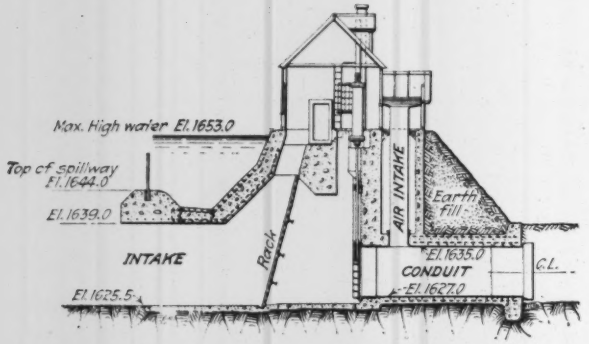


FIG. 1—PLAN AND PROFILE OF THE SEARSBURG HYDRO-ELECTRIC DEVELOPMENT

The dam itself presents no unusual features. It is a simple earth structure slightly more than 50 ft. high in the middle of the stream with a base approximately 240 ft. wide and a crest 20 ft. wide. The total length of the dam, including spillway, is about 550 ft. The earth section, however, is only slightly more than 200 ft. The 55,000 cu.yd. of earth fill required for the dam was obtained from borrow pits opened in the easterly hillside mostly above the dam approximately a quarter of a mile away. This fill, which was a combination of clay and gravel, was excavated with 1½-yd. steam shovel, full revolving type, and was brought to the dam site in trains of four yard dump cars drawn by 30-in. gage locomotives. Two trains of cars were operated continuously and it was found possible to take the output of the 1½-yd. shovel practically continuously.

The first work at the dam was the construction of a temporary bypass. The ledge at the west bank of the river was blasted out and a concrete wall constructed 10 ft. thick at the base and in height and width following the section of the drain. This wall formed the abutment for the fill as well as forming part of the permanent spillway. Buttresses extended into the fill to prevent leakage along the wall. No cofferdam other than the deposit of earth was required to divert the stream through the temporary bypass, although some rocks from the excavation were placed from a low trestle at the upstream edge of the fill to serve as a partial breakwater.

Building the Dam—The plan of operation was to place the earth fill by dumping from temporary wood trestles placed about 100 ft. apart and constructed of local timber. When the fill had reached a height of about 15 ft. dumping was suspended and the bed of the river between the two lines of fill cleared of boulders and river silt, leaving the undisturbed hardpan clay bottom of the river bed exposed. Dumping was then resumed and as the fill was deposited in the middle of the dam the fine material was washed to the center by two fire streams playing continuously. This formed the core of the dam. This core was carried well into the east bank of the river. The sluicing resulted in a pond being formed in the middle of the dam which



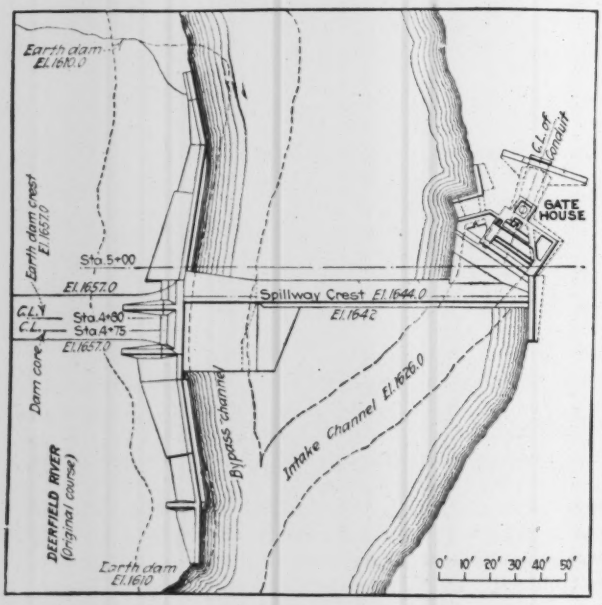


FIG. 2. INTAKE AND SPILLWAY STRUCTURE

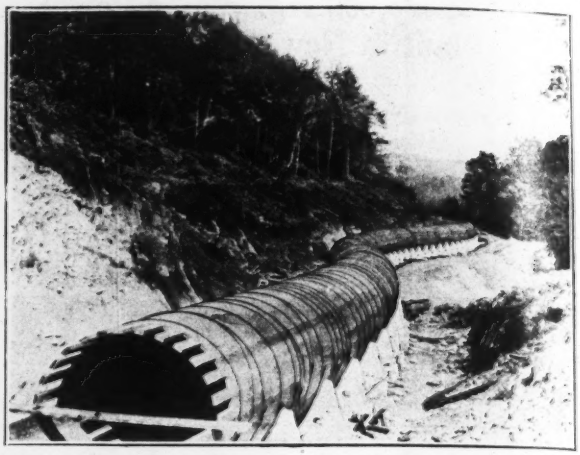


FIG. 3. WOOD-STAVE PIPE UNDER CONSTRUCTION
Pipe is 8 ft. in diameter and line is nearly 4 miles long, constituting the largest installation of this type in New England.

thoroughly puddled the fill as it was placed. The two fire streams were supplied with water from this pond by a two-stage electrically-driven pump located on a raft in the pond. Make-up water was supplied from up-river by a 6-in. single-stage pump. The pond in the central portion of the dam was discontinued when the grade of the spillway was reached—approximately 15 ft. below the crest.

When the fill had reached the height of the top of the trestles the upper work of the trestles was removed and the track jacked up as the fill rose. To take care of the settlement of the fill an over-slope of about 10 per cent was placed. The flood line above the dam included about 20 acres of land, about 14 acres of which had to be cleared.

Wood-Stave Pipe—The largest single item in the contract, and the one which involved the most difficulty from a construction viewpoint, was the building of the berm or bench for the wood-stave conduit and the placing of the conduit itself. The only practical location for the conduit was on the slope of the river bank. The river winds more or less and as previously stated the bank is quite precipitous and heavily wooded. Where the bank curved sharply, studies were made of the possibility of tunneling through rather than curving the conduit around the hillside, but the uncertain nature of the excavation, with the probability of encountering boulders and ledge if the conduit were directed through a tunnel, showed economy in favor of the hillside location.

Following the location of the conduit a clearing gang went ahead and cut down the trees and brush in a swath approximately 100 ft. wide, this width being considered necessary to afford proper fire protection to the wood pipe. This clearing approximated thirty-five acres.

A force of men called the prospecting gang followed the clearing gang. It was the duty of this crew to determine as closely as possible the exact nature of the digging which the steam shovels would be called upon to handle, and to remove as far as possible any obstacles. The gang dug test pits, drilled test holes and also did considerable blasting. To carry out this preliminary work effectively a narrow berm was cleared by hand on practically the center line of the pipe to

allow travel and to provide a space in which to run the water line for the steam shovels.

Two 1-yd. steam shovels were used in excavation of the berm. These shovels came by rail to Mountain Mills, where they were transferred to the narrow-gage rails and transported to the site. They were assembled at the foot of the hill near where they were to cut in and it was necessary to build temporary roads to get them up the bank. Shovel No. 1 was cut in at Medbury Brook about 2,000 ft. upstream from the surge tank at an elevation about 150 ft. above the highway at this point. This shovel worked back to the surge tank, after which it returned and worked continuously upstream until it reached the point where shovel No. 2 had started. The excavation by shovel No. 1 totaled 29,000 cu.yd. of earth and 5,600 cu.yd. of rock.

Shovel No. 2 was cut in at approximately a halfway point of the berm and worked upstream to the dam, removing in all about 48,000 cu.yd. of earth and approximately 1,500 cu.yd. of rock.

The difficult nature of the digging is well indicated by the fact that the shovels, which operated day and night, often advanced only 40 ft. in 24 hours, with an average for a full month's work of about 110 ft. in 24 hours. All of this excavation was in the hillside and, for the most part, the excavated material was simply dropped over the low side of the slope by the shovel. At some points, however, spurs of the hills ran out flat, and in these cases it was necessary to move some of the excavated material by teams. Many fingers of ledge were uncovered as the shovels progressed and had to be blasted out. This excavation averaged about 4.3 cubic yards per foot of conduit.

Details of Pipe—The 8-ft. wood-stave conduit is the only wood penstock of appreciable length in New England. This was furnished and erected by the Continental Pipe Manufacturing Co. The contract called for 1,600,000 board feet of Douglas fir staves 2½ in. thick, average length 14 ft., as well as some 600 tons of ¾-in. steel bands and 70 tons of malleable cast shoes. This material was all unloaded, stored and placed on the berm by the general contractor. Fifty-seven staves completed the conduit circumference. Accordingly, staves were placed on the berm in piles of 114 staves each, all of one length, as near as possible at exact points. This was done not only to eliminate handling, but to prevent damage through excessive handling. The ends of the staves were slotted to receive steel tongues, about 11 tons of which were used.

The concrete cradles supporting the conduit were supplied by the general contractor. These cradles were in two pieces and were cast in molds at Mountain Mills and transported by rail and team to the berm where they were distributed along the conduit line. Of these precast cradles 2,090 were used, while about 100 were cast in place. All were placed on reinforced-concrete foundations.

Where the conduit crossed brooks or ravines wood trestles were erected with the assistance of the steam shovels, a total of about 900 ft. of such trestle being necessary. Where Medbury Brook and Bond Brook entered the river through deep cuts, siphons were placed in the conduit line. At these brooks, also, 24-in. wood pipe intakes were cut into the main conduit. The shortest allowable radius for wood conduit was 300 ft. Where sharp curves occurred special steel bends were provided, six of these being installed at different points, radii varying from 40 deg. to 90 deg. Where the conduit line crossed the Bennington Road is was necessary to blast out the ledge and build a special flat section of conduit in concrete, the road passing over this.

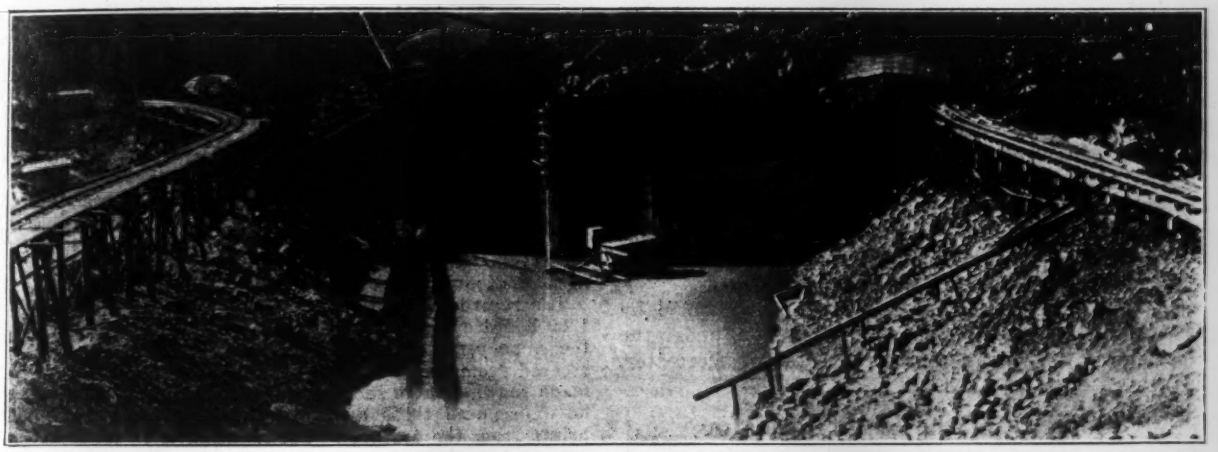


FIG. 4—RETAINING WALL AT WEST END OF DAM SHOWING TRESTLES FROM WHICH EARTH WAS DUMPED

Spillway—Fig. 2 shows a plan and cross-section of the intake and spillway structure at the dam. This was all built in solid rock, and, including the temporary bypass, necessitated the removal of more than 6,000 cu.yd. of rock as well as about 1,500 cu.yd. of preliminary stripping. The mechanical equipment at the dam consists of two 6 x 8-in. cast-iron sluice gates, one of which controls the water entering the conduit, the other being used to bypass the water down the river bed, thus aiding in the flood control. These gates are operated by oil cylinders 16 in. in diameter, pressure for which is supplied by a 30 gal. electrically driven triplex pump. The normal operating pressure for the cylinders is about 200 lb. per sq.in.

The downstream end of the conduit terminates in a concrete Y, one branch of which is connected to the surge tank and the other to the steel penstock which drops to the power house.

The surge tank is of the Johnson differential type

50 ft. in diameter and 35 ft. high, the vertical steel section being set in the concrete of the foundation without a steel base. This tank is partially protected from freezing by a wooden housing. Nearly one thousand yards of earth and rock were removed at this point for the surge tank foundation, while the foundation itself required more than 600 cu.yd. of concrete.

The penstock is 6 ft. 6 in. in diameter, approximately 500 ft. long, of steel plate varying in thickness from $\frac{7}{16}$ in. at the concrete Y to $\frac{5}{16}$ in. where it enters the power house. The steep slope at this point was fairly clear and little preparation was necessary for the penstock line other than the construction of the supporting concrete blocks.

Power Equipment—The power house is a concrete and brick structure 34x41 ft. with a gunite roof slab on a steel frame. The equipment consists of a 5,000 kva., 4,500 kw., 360 r.p.m. General Electric generator with the necessary auxiliary switchboards, transformers, oil switches, lightning arresters, etc. The generator is driven by a 6,200-hp. vertical turbine with cast steel spiral case built by the I. P. Morris Department of the William Cramp & Sons Ship and Engine Building Co. At the turbine inlet there is a Wellman-Seaver-Morgan Co. balanced plunger hydraulic valve, by means of which water can be shut off from the unit.

This development not only adds materially to the amount of power developed by the New England Power Co., but is also of considerable value as further controlling the Deerfield River, which was already extensively developed below the Searsburg location.

The general contract for the work was handled by Aberthaw Construction Company, of Boston, under the direction of the Power Construction Co., of Worcester.

Publicity of the Right Kind for Water-Works Properties

Extracts From a Paper by Dow R. Gwinn, President and Manager, Terre Haute Water Co., Presented to the Iowa Section, American Water Works Association

SOME operators take their publicity matter to the editor when they should see the advertising manager. They fail to distinguish the difference between news and advertising matter. An operator, who would resent the suggestion that he furnish service free of charge, should keep that idea in mind when he goes to the newspaper office with copy. A newspaper must charge for advertising matter. Therefore, when you wish to acquaint the public with facts about the water-works business, see the advertising manager and make a contract for space.

Plenty of time should be taken in the preparation of copy. If a series of advertisements are to be used, it is advisable to start in with one of a historical character. Prepare a second with some of the difficulties of a practical character that have been overcome. The third insertion could give a description of the present system. Somewhere through the series the name of the engineer or engineers should be given, the trouble in financing the enterprise and the names of those who bore the responsibility of getting the works started.

It is a mistake to try to tell too much in one issue of the paper. In most cases 5 in., three columns wide, is sufficient space, with at least two insertions of each story or talk. Change copy weekly. Contract for space on the editorial page if it is used for advertisements. It is advisable to complete copy for the entire series before beginning publication.

The public should be taken into the confidence of the water-works operator; it is poor policy for the public to get the idea that the operator is covering up something. Let the public know what you are doing. If you contemplate important improvements, take space in the newspaper and state what you are about to do, whom you have engaged to plan the work, the standing of the engineer and what he has done in other cities. If an application is to be made for an increase in rates, space should be bought for making the announcement and full particulars should be given so that the public will be able to judge as to the reasonableness of the claim for higher rates.

After or during the publication of a series of advertisements (call them "water talks" if you please), an effort should be made to get the public to visit the pumping station and other portions of the plant. Incidentally, the grounds around the station should be made attractive and pleasing. Our grounds are desirable for picnics and we invite the public to use them.

During the past summer the Rotarians, the Kiwanis Club and the Exchange Club served noonday luncheon on our grounds; the Lions and their wives served supper. We have tables (trestles and boards) sufficient for 140 people; our men set the tables, cover them with white paper (it comes in rolls), put on the glasses, forks and spoons. The caterer, who is engaged and paid by the club using the grounds, furnishes the food, plates and paper napkins. We furnish the water, coffee and sometimes small bottles of milk. In this way the live wires of the city, the men who are doing things, visit our plant, see what we have and, judging by many comments, go away with a good impression of the local water-works plant. Of course, the newspaper men are present and the luncheons are duly written up, usually with some reference to the water-works. It is always favorable publicity.

We have an unusually fine tennis court which may be reserved by telephone, no charge being made. The finals of tennis tournaments are played on the water-works court.

The record of fatal typhoid cases in Terre Haute since 1909 has dropped from 60 to 5 per 100,000 population. In the same period the number of water consumers has increased from 5,200 to 9,000. A drawing 8½ x 11 in. was made showing these facts graphically. For three years we have prepared these drawings and have about 400 blueprints from the tracings. These prints have been mailed to a selected list of names, including the state health officials, members of the Public Utility Commission, local officials, physicians, nurses, college and school principals and all members of the Rotary Club.

The writer is of the opinion that the best form of advertising is through the public press, but there are occasions when a personal letter, multigraphed with typewritten address, is effective. A special letter was sent recently to real estate men advising them that the price of cast-iron pipe was extremely high; that money was dear and hard to get and that a survey showed over 2,500 vacant lots on the lines of existing water mains. Blueprints of the survey were inclosed. We also enclosed an extract from Mr. Brigham's article in the *Atlantic Monthly* for March, 1921, to the effect that the United States Housing Corporation could have built houses where utilities were already installed much more quickly and cheaply than in new locations, that the cost of improved vacant lots in the city was less than the improved acreage plus the great cost of utilities.

California Forest Fire Losses

According to a preliminary estimate made by the U. S. Department of Agriculture fire losses in California national forests during the past season amounted to $134,000. Fires burned over a total of 290,800 acres, of which 192,000 acres were government land. Some of the watersheds in the state were severely damaged through destruction of their forest covers. Lightning set 25 per cent of the fires. The effective fire detection and suppression organization of the U. S. Forest Service made possible extinguishment of 80 per cent of the fires before they had covered 10-acre areas.

Remove Subaqueous Ledge Above Rapid Transit Tunnel

Special Precautions Safeguard New York Subway Tubes During Channel Improvement—Fire Blasts Are Made Between Trains and Close Inspection Is Maintained

By Col. Edward Burr
Corps of Engineers, U. S. A.
Officer-in-Charge First New York Engineer District

THE improvement of East River as now carried on by the United States contemplates a channel 40 ft. deep at mean low water with a standard width of 1,000 ft., narrowed at points where topographical conditions make it necessary for reasons of excessive cost. The estimated cost of the improvement under existing general cost conditions is about $72,000,000, this high cost being due to the large yardage of submarine ledge to be removed in strong currents and congested traffic.

Among the items of work is the removal of a ledge shoal which was approximately centered over the Old Slip-Clark St. tubes of the rapid transit system operated by the Interborough Rapid Transit Co. This shoal had a least depth to ledge rock of about 31 ft. at mean low water and an area of about 105,000 sq.ft. that was less than 40 ft. deep. The quantities involved were 9,544 cu.yd. of ledge rock to 40 ft. depth and 15,406 cu.yd. to 42 ft., with average depths of cut of 2.5 and 4.5 ft. respectively, payment being made at full contract price for material removed between 40 and 42 ft. The quantities of dredgeable material to be removed were 4,314 and 6,425 cu.yd. to 40 and 42 ft., respectively.

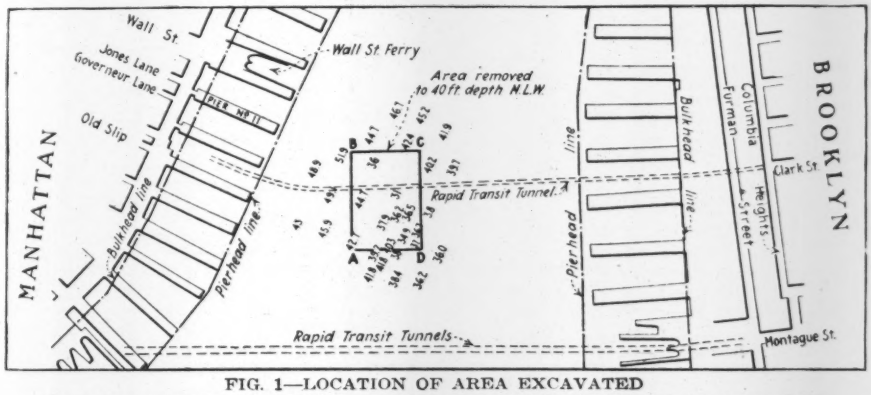


FIG. 1—LOCATION OF AREA EXCAVATED
The seismograph was installed in a cross passage between the tubes under the easterly edge of the area to be removed.

After customary advertisement a contract was entered into with the New Jersey Shipbuilding and Dredging Co. on Sept. 2, 1919, the work being due for completion on Nov. 24, 1921. Dredgeable material having first been removed, the contractor began drilling and blasting in November 1920, but his plant was seriously injured by collision after but three days operation. Drilling and dredging operations, either separately or jointly, have continued since that time with interruptions and delays resulting from collisions by passing traffic, more or less serious, and the work is now completed excepting for the removal of a few high points which have been developed by sweeping and which may be broken rock.

Proximity of Tunnels—This contract, in addition to the normal difficulties found in removing ledge to 40 ft. depth (45 ft. at m.h.w.) in the traffic and tide currents of East River, presented special problems resulting from the existence directly under the highest point of the reef of twin rapid-transit tubes 66.2 ft. below m.l.w. measured to the iron lining. It was essential to conduct blasting without damage to the tubes, undue delays to traffic and even without alarming passengers, bearing in mind a serious tunnel accident in Brooklyn a few years earlier. These ends were all attained and the public was not aware of the execution of the work until its completion.

On the other hand, for economic reasons, it was desirable and necessary also that blasting should result in breaking up the ledge into condition suitable for effective dredging, with the minimum of high points of unbroken ledge and consequent costly re-drilling, drilling, and blasting operations representing from 70 to 80 per cent of the total cost of a successful contract. The adjustment of these conflicting elements of the contract was the special problem to be solved and, so far as concerned the conduct of blasting, adjustments were a continuous process so long as blasting was necessary.

The ledge under the lower section of East River includes schist, gneiss and granodiorite of varying composition and hardness, from quartz seams to disintegrated surface rock. The records made during the driving of the tubes had been destroyed by fire but it was learned generally that this ledge was unusually hard and free from fissures. From other sources, including a geologic examination of the entire East River area by Dr. Charles P. Berkey of Columbia University, it was learned also that the rock was Fordham gneiss of characteristic type, with dip of nearly 90 deg. towards the west and a strike nearly parallel to the long axis of the contract area.

The best practice among contractors for ledge removal in the East River channel in recent years is based upon drill holes 5 to 7 in. in diameter, spaced 10 ft. centers and driven to 10 ft. below grade, with the object of breaking out the ledge so as to leave no points above grade and thereby require redrilling which, if extensive, largely increases costs. Layout of holes and similar matters are determined by the types of drilling plant as affected by tide currents.

Provisions for Safety—After consultation with the engineers of the Public Service Commission, the specifications, in addition to bringing out the existence of the tubes, carried special provisions, calling attention to the tunnel traffic, prohibiting blasting between 7 and

10 a.m. and 4 and 8 p.m. in order to avoid unnecessary interruption to that traffic, and requiring that the exact moment of blasting should be governed by a system of signals to be adopted by agreement between the contractor and the Public Service Commission. Also as a precautionary measure, they prohibited the drilling of holes more than 7 ft. below grade, i.e. deeper than 47 ft. below m.l.w. In other respects the specifications were the standard for such work. Early in the contract a system of inspections, reports and studies was developed to meet the special conditions, to furnish needed information to all concerned, and to permit of effective control of the next steps as required for safety and avoidance of delays.

The circumstances of the work required the development of reliable means of prompt inter-communication between the contractor's plant and the train dispatcher's office at Wall Street station. The responsibility for all necessary arrangements rested with the contractor but cordial co-operation between him, the Transit Construction Commission (T.C.C.) (subsequently the Transit Commission), the Interborough Rapid Transit Co. (I.R.T.) and the District Engineer (D.E.) led to successful methods without friction.

Direct telephone connection was attempted through a cable extending from the end of Pier 11 on the Manhattan shore to a barge moored near the contractor's drill boat, the attachment of the cable to the latter being impracticable for various reasons. The cable was installed but owing to cable and other troubles this method was found so unreliable that it was abandoned before blasting began. Resort was then had to visual signals between the drill boat and a shore station, with wire connections thence to the dispatcher's office. After using for a few days Old Slip police station, the shore station was subsequently established at the outer end of Pier 11. In each case communication with the dispatcher's office was by telephone but a buzzer system was soon installed between Pier 11 and the dispatcher's office and served successfully for the greater part of the work. For day signals between the drill boat and Pier 11 a red flag with square white center was adopted, and for night signals three lights, red, white and green on a vertical line.

Inspection Procedure—Drilling and blasting were conducted at first on a 16-hr. basis, but for most of the work on a 24-hr. basis. When the blasting had reached a stage to justify it, the routine was as follows. After each blast the contractor furnished information as to the approximate time of next blast. This could be done with fair accuracy based on periods of no firing and the time of slack water which, when practicable, was used for firing because of the necessity for moving the drill boat from above the holes before firing and back into position after firing. At the specified time the following force reported: At Pier 11, one I.R.T. signalman, one T.C.C. and one U. S. inspector; at Wall Street station, one T.C.C., one I.R.T. and one U. S. inspector. A U. S. inspector was at all time on duty on the drill boat. The contractor sent an inspector to the Wall Street group at times only.

When ready to fire the drill boat hoisted its signal (flag or lights) and the signalman (I.R.T.) answered by waving a red flag or red light. The signalman sent one long ring on buzzer to dispatcher who answered with one long ring on buzzer. The tunnel inspectors took the next train for their posts in the tunnel and on arrival there the I.R.T. inspector notified the dispatcher of their readiness. Meanwhile the dispatcher cleared the tubes of traffic and then sent one ring on telephone to the inspector in the tunnel as a ready signal and two long rings on buzzer to the signalman on Pier 11, who answered with two long rings and hoisted his signal (flag or lights), indicating that tubes were clear and blast could be fired. The drill boat fired the blast and lowered its signal to show that blasting was completed. The signalman at Pier 11 lowered his signal and gave the "all over" signal, three rings on buzzer to dispatcher who replied with three rings. Tunnel inspectors noted the effect of blasting and when satisfied that it was safe to start traffic, notified the dispatcher by telephone and he started the trains. The tunnel inspectors took the next train to Wall Street station and reported to their respective offices by telephone of the effect of blasting. The U. S. inspector also submitted a detailed report on the prescribed form giving all the details of each blast.

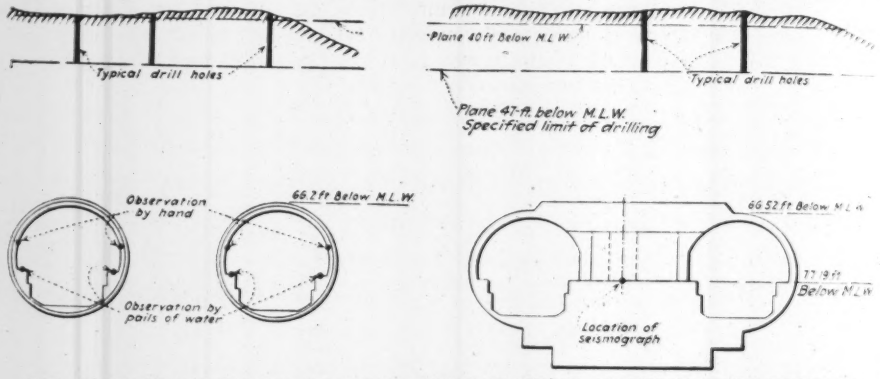


FIG. 2—TYPICAL CROSS-SECTIONS SHOWING POSITION OF TUBES WITH RESPECT TO ROCK SURFACE

The cross-section to the left is typical of conditions under nearly all of the area of excavation and shows the points at which observations were taken by hand and by pail of water.
That to the right is a special section at the cross-passage in which the seismograph was installed. This lies under the easterly edge of the area excavated as indicated in Fig. 1.

All signalling was done by employees of the contractor and I.R.T., who were the responsible parties, the U. S. and T. C. C. inspectors being merely observers. Normally the interval from the time tunnel was reported "cleared" to the time dispatcher was notified that it was "O. K." was between two and three minutes, and delay to traffic seldom occurred or was of short duration. The basic control of blasting was that no firing was permissible excepting while the signals were up on both the drill boat and Pier 11, and that these signals when hoisted, remained up until blasting was completed. For communication not possible through these signals and for prompt transmission of instructions the contractor maintained a motor launch at Pier 11.

Devices for Observing Vibration—Accurate and entirely reliable means for determining the amplitude of vibrations on the tube structures were lacking, but some

measures was necessary to gage the varying effects of blasting. Although these were distinctly noticeable through the report or noise of the detonation or through the vibration or jar observed by personal contact (through hands or feet) with the tube structure, they had no physical effect upon it. Inexperienced observers usually will construe a sharp report or noise as indicating a marked physical vibration.

All of the following means were regularly used: (a) An improvised seismograph installed by the T. C. C. in the cross-passage between the tubes, located under the easterly edge of the ledge area to be removed. This instrument recorded the amplitude of both horizontal and vertical vibrations but was not always reliable. Moreover it was relatively distant from the point of most intense shock during the critical period of blasting directly over or immediately adjacent to the tubes. (b) A pail, partially filled with water, with a light float carrying a vertical pointer that indicated the amount of disturbance of the water surface on a horizontal scale supported above the rim of the pail. This primitive method lacked sensitiveness, but, used at the point of maximum intensity, it gave indications for shocks smaller than those physically affecting the tubes, and was reliable. (c) By holding the hand against the tube wall in direct line with the blast. This method was merely a check on others but was of value. (d) Observation of incandescent light filaments, through dark glasses. This was an additional check, which was used after the filament in one tunnel lamp had been broken by concussion. (e) A thorough examination of the tubes after each blast, in the vicinity of the blast, noting effects such as dislodgment of dust or of other light encrustations.

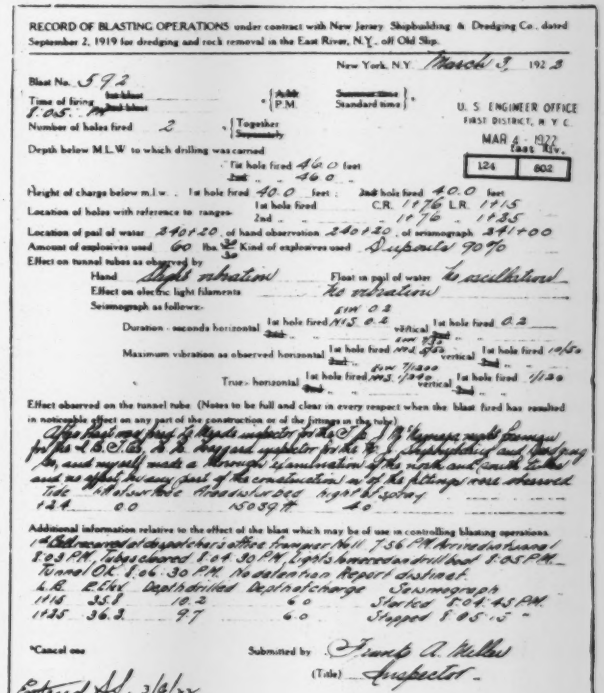
Tests (b), (c), and (d) were developed by the contracting officers' organization and, though crude, were of value in indicating measurably severe shocks, insufficient to cause material damage to the tubes.

Sequence of Operations—For administrative reasons the contract area was divided into four sections by lines nearly parallel to the axis of the tubes. Section 2 was 125 ft. wide, with the two tubes occupying a width of about 50 ft. near its center. Blasting was begun at the end of the area most remote from the tubes and carried forward to the boundary of Section 2. It was then started at the other end and brought up to Section 2, thus leaving the work nearest to and over the tubes until there was available all the experience gained as the blasting progressed.

The drilling plant consisted of a boat carrying three drills for drilling three holes at a setting. After loading the holes, the boat was hauled off, the blast fired and the boat hauled back to its next location as established by shore ranges. The explosive was Dupont's 90 per cent blasting gelatin, loaded in tin canisters or tubes, and three holes were fired at a blast.

Blasting Practice—When blasting was begun, at a distance of about 275 ft. from the nearest tube, no restrictions were placed upon the normal practice of the contractor who used for three holes a total charge varying generally between 100 and 150 lb. and a few charges more than 150 lb. and as high as 200 lb. During this period there were experienced some of the more severe shocks to the nearest tube, but these effects were so irregular that their prediction was difficult or impossible and they were a most unsatisfactory basis for determining the size of the charge. By the time the work had approached to 40 ft. horizontally from the line of the nearest tube, the necessity for close regulation of the total charge for each blast had become evident and it was progressively reduced from 80 or 100 lb. to 30 lb., in the area directly over the tubes where the least distance from the bottom of the hole to the tube lining was as little as 18 feet.

For effective blasting, the concentration of this charge in one hole was necessary, and the firing of but one hole in a blast was permitted. It was found that on 10-ft. centers the firing of one hole would generally detonate the second and the contractor resorted to drilling on 20-ft. centers, using the two outside drills of his plant, and fired the two holes separately at a few



RECORD OF BLASTING OPERATIONS under contract with New Jersey Shipbuilding & Dredging Co., dated September 2, 1919 for dredging and rock removal in the East River, N.Y., off Old Slip.

New York, N.Y. March 3, 1923

Blast No. 592

Time of firing 1st blast 1.05 P.M. 2nd blast — (A.M. / P.M.) (Summer time / Standard time)

Number of holes fired 2 (Together / Separately)

U. S. ENGINEER OFFICE FIRST DISTRICT, N. Y. C. MAR 4 - 1923 East Riv. 124 602

Depth below M.L.W. to which drilling was carried: 1st hole fired 46.0 feet; 2nd " " 46.0 "

Height of charge below m.l.w. 1st hole fired 40.0 feet; 2nd hole fired 40.0 feet

Location of holes with reference to ranges: 1st hole fired C.R. 1076 L.R. 1115; 2nd " " 1076 " 1135

Location of pail of water 240+20 of hand observation 240+20 of seismograph 241+00

Amount of explosives used 60 lbs. Kind of explosives used Dupont's 90%

Effect on tunnel tubes as observed by:
Hand Slight vibration. Float in pail of water Very slight vibration.
Effect on electric light filaments No vibration.
Seismograph as follows:
Duration - seconds horizontal 1st hole fired .15 0.2 vertical 1st hole fired 0.2
Maximum vibration as observed horizontal 1st hole fired .004 .005 vertical 1st hole fired 1/60
True - horizontal 1st hole fired .005 1/200 vertical 1st hole fired 1/120

Effect observed on the tunnel tube (Notes to be full and clear in every respect when the blast fired has resulted in noticeable effect on any part of the construction or of the fittings in the tube)
After first report I, Hyatt inspector for A. S. B. & D. Co. Engineer Smith Foreman for the A. S. B. & D. Co. and myself made a thorough examination of the north and south tubes and no effect by any part of the construction or of its fittings was observed.
Tide at Battery Hook 1.05 P.M. Sandy Hook 1.05 P.M.
124 00 150 S.W. 40

Additional information relative to the effect of the blast which may be of use in controlling blasting operations.
1st hole record of dispatcher's office transport No. 11 7.56 P.M. Arrived at hand 8.03 P.M. Tugs cleared 8.04.30 P.M. Lights shipped and drill boat 8.05 P.M.
Tunnel OK 8.06.30 P.M. No explosion report distinct.

L.R.	C.R.	Depth drilled	Depth of charge	Seismograph
1115	35.8	10.2	6.0	Started 8.04.45 P.M.
1135	36.2	9.7	6.0	Stopped 8.05.5 "

*Cancel one

Submitted by Frank A. Keller (Title) Inspector

Entered A.S. 3/6/23

FIG. 3—FAC-SIMILE OF A BLASTING REPORT

seconds interval, thus obtaining the maximum drilling capacity for each setting of his drill boat. It was necessary at times to use part of the charge as a surface blast over the hole even though the use of such charges produced more pronounced effects on the tubes than equal amounts loaded in the drilled holes.

Shortly after blasting was commenced, an examination of the tubes was made jointly by representatives of all parties interested and a full record made of conditions then existing. While the blasting generally was effective in breaking the ledge into condition suitable for dredging with little re-drilling, no effects of any consequence resulted to the tubes, which were in no wise damaged, a combined result that was most satisfactory.

Personnel—The work was done under the direction of Colonel Edward Burr, Corps of Engineers, U. S. Army, in charge of the First New York Engineer District. J. H. Rostock, assistant engineer, had direct supervision of contract operations. Much of the success was due to painstaking services of the inspectors and to the accuracy of their observations and reports.

Volumes at Jack-Arch Groins

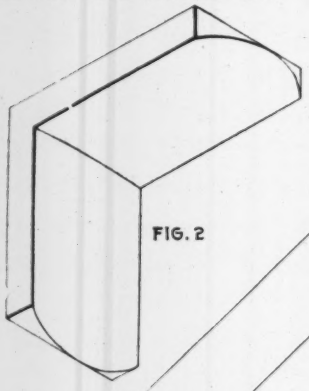
By George Paaswell
Construction Engineer, New York City

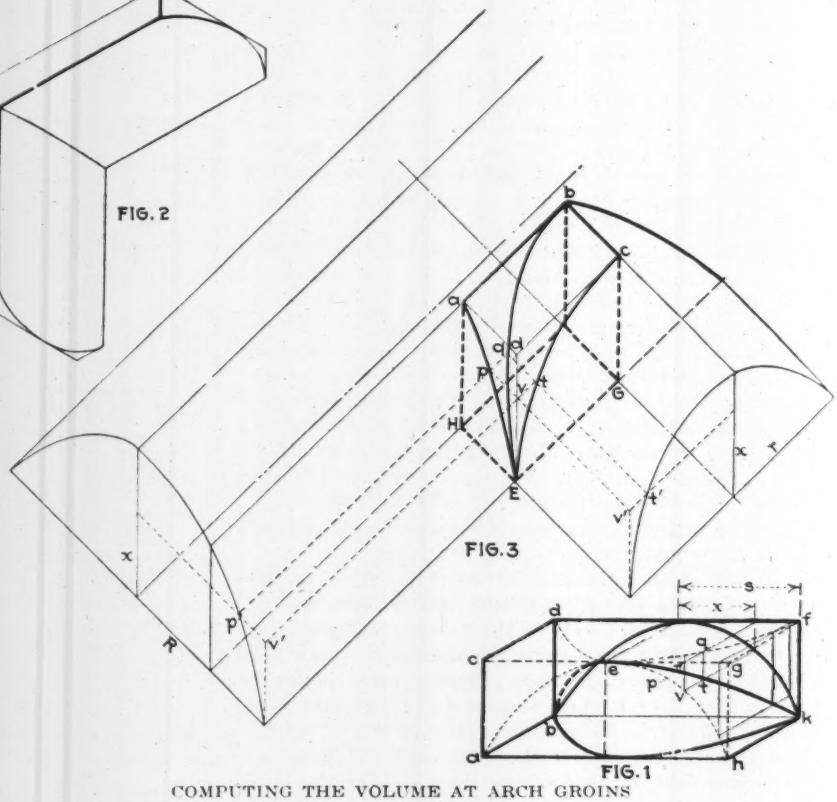
A PROBLEM of frequent occurrence is that of determining the volume at the groin of two intersecting arches. Referring to the figure, the required volume may be found as follows: Compute the volume of the two intersecting arches separately, carrying the length of arch (Fig. 1) to the planes *acgh* and *cdfg* respectively. There has been included two times, then, the volume of the two curvilinear pyramids *abcd* — *e* and *gfkh* — *e*. These are equal figures. It is necessary to deduct from the sum of the two arch volumes the volumes of the two pyramids. The following analysis covers the computation of this latter volume.

By referring to Fig. 3, it is seen that the intersection in Figs. 1 and 2 is a special case of the more general intersection of two cylinders. The process of finding the volume is the same in the general case and the same method is employed of deducting the volume of the common pyramidal figures.

Exact Solution and Tables—In Fig. 1, a typical section of the pyramid is the rectangle *pqvt*. Denote the radii of the two arches by *r* and *R* respectively, *r* being the smaller radius. The sides of the rectangle are the two circular offsets, *pq* and *pv*. The method of finding the curve of intersection *bek* of the two cylinders is indicated in the figure. The offsets are computed from the common edge *cg*. The circular offset from a tangent is

$$R - \sqrt{R^2 - x^2}$$





COMPUTING THE VOLUME AT ARCH GROINS

Taking the thickness of the rectangle as the infinitesimal *dx*, the total volume of the two equal pyramids is given by the integral

$$V = 2\int_0^s [R - \sqrt{R^2 - x^2}]\ [r - \sqrt{r^2 - x^2}]\ dx$$

Multiplying the two factors, the integral is broken up into four simpler ones, thus

$$V = 2Rr\int_0^s dx - 2R\int_0^s \sqrt{r^2 - x^2}\ dx -$$

$$2r\int_0^s \sqrt{R^2 - x^2}\ dx + 2\int_0^s \sqrt{(R^2 - x^2)\ (r^2 - x^2)}\ dx$$

The first three of these may be integrated by elementary methods, but the last leads to elliptic integrals. Upon denoting by *k* the ratio *r*/*R* of the smaller radius to the larger, and by *t* the ratio *s*/*r* of the half span of arch to the smaller radius, the volume is finally found to have the form

$$V = KR^3$$

where

$$K = \Big[k^3t\Big\{2 - \sqrt{1 - t^2} - \sqrt{1 - k^2t^2} + \tfrac{2}{3}\sqrt{(1 - t^2)\ (1 - k^2t^2)}\Big\} - k(\sin^{-1} kt + k\sin^{-1} t) + \tfrac{2}{3}(1 + k^2)E - \tfrac{2}{3}(1 - k^2)F\Big]$$

In this expression *E* and *F* are elliptic integrals of order two and one respectively. They are defined by the integrals

$$E = \int_0^t \sqrt{\frac{1 - k^2x^2}{1 - x^2}}\ dx \qquad F = \int_0^t \frac{dx}{\sqrt{(1 - x^2)\ (1 - k^2x^2)}}$$

In order to evaluate these integrals, in the absence of proper tables it was necessary to expand the integrals into series and integrate term by term.

Table I gives the values of *K* for a range of values of *k* and *t*. It must be remembered that *r* is the smaller radius.

Approximate Solution—An approximate expression for the volume may be found, using a parabolic equation for the arch in place of the true circular. This method is based upon the following equation for the offset:

$$y = x^2/2r$$

The total volume is then given by

$$V = 2\int_0^s \frac{x^2}{4rR}\ dx$$

Upon integration and substitution of *k* and *t*, the volume becomes

$$V = LR^3$$

where $L = k^4t^5/10$

A study of this expression indicates that it gives results within a reasonable limit of error when both k and t lie between 0 and $\frac{1}{2}$.

TABLE I—VALUES OF k

k/t	0.2	0.4	0.6	0.8	1.0
0.2	0	0	0.00001	0.00001	0.00003
0.4	0	0.00003	0.00014	0.00048	0.00109
0.6	0.00001	0.00022	0.00111	0.00359	0.00899
0.8	0.00007	0.00099	0.00486	0.01689	0.04408
1.0	0.00022	0.00262	0.01915	0.06531	0.19174

Volume in Terms of Rise and Span—Quite often the arch is defined by its rise and span rather than by the radius and span. If the rise of an arch with radius R is denoted by h, and that of the arch with radius r by m, then, from simple geometry

$$R = \frac{s^2 + h^2}{2h}\,;\; r = \frac{s^2 + m^2}{2m}$$

If the ratio h/m is denoted by u and the ratio of m/s by v, then the values of k and t may be expressed directly in terms of u and v, and the foregoing table used to find the volume when the rise ratios and span to rise ratio are known. Thus

$$\frac{r}{R} = k = u\,\frac{1 + u^2v^2}{1 + u^2}$$

and

$$t = s/r = \frac{2v}{1 + v^2}$$

TABLE II—VALUES OF k

u/v	0.2	0.4	0.6	0.8	1.0
0.2	0.19	0.38	0.45	0.50	0.52
0.4	0.19	0.36	0.47	0.54	0.58
0.6	0.20	0.36	0.50	0.60	0.68
0.8	0.20	0.36	0.54	0.69	0.84
1.0	0.20	0.40	0.60	0.80	1.00

Table II gives the value of k in terms of u and v and Table III the values of t in terms of v.

TABLE III—VALUES OF t

v	t	v	t
0.1	0.2	0.6	0.88
0.2	0.38	0.7	0.94
0.3	0.55	0.8	0.98
0.4	0.69	0.9	0.99
0.5	0.80	1.0	1.00

When the angle of intersection of the two arches, or of the two cylinders is not a right angle, the foregoing formulas may be applied with a slight correction. The element of volume is now a lamina with face a parallelogram. The sides still have the lengths as determined before, and if the acute angle of intersection is ϕ, then the element of volume becomes,

$$\sin\,\phi\left\{r - \sqrt{r - x^2}\right\}\left\{R - \sqrt{R^2 - x^2}\right\}dx$$

and the final formula takes the form $V = KR^3 \sin\,\phi$.

Lumber Varieties by States

Arkansas is the leading lumber state in the production of red gum, hickory, ash and sycamore, according to information compiled by the National Lumber Manufacturers Association. California leads in redwood, white fir and sugar pines. Louisiana is first in yellow pine, Colorado in lodgepole pine, Idaho in larch, Indiana in beech, Maine in balsam fir, Michigan in maple, Minnesota in white pine, Mississippi in cottonwood, Missouri in walnut, Oregon in western yellow pine, Tennessee in oak, Washington in Douglas fir, spruce and cedar, West Virginia in chestnut and yellow cedar, and Wisconsin in hemlock, birch, elm and basswood.

I.C.C. Reviews Status of Tests of Automatic Train Control

THE present status of the Interstate Commerce Commission's study of automatic train-control is summarized in its annual report, covering the period from Nov. 1, 1921, to Oct. 31, 1922. The various devices for train-control and their success in practical use are discussed as follows:

IN OUR last annual report we stated that arrangements had been made by our bureau of safety and a joint committee of the American Railway Association for observations under service conditions of three automatic train-control devices of the intermittent electrical contact type.

These observations, made during the period from May, 1921, to March 31, 1922, disclosed that 148.8 miles of road, 276.6 miles of track, 142 engines, 276 indication points, and 275 signals were equipped. The engines travelled 721,581 miles in the equipped zones, and the total number of operations observed was 659,875. The tests demonstrated that automatic train-control devices observed have been developed to the point where now they are practicable under actual service conditions; that they perform their intended functions and that, when properly installed and maintained, they increase the safety of train operation. During the tests some features undesirable from an operating standpoint were disclosed, but these can be corrected as the devices are installed and utilized more extensively.

I.C.C. Requirement—In June, 1922, we adopted specifications and requirements for the installation of automatic train-stop or train-control devices and ordered 49 carriers to install upon a full passenger-locomotive division, included within designated portions of their respective lines, a device in accordance with these requirements. We have not recommended any particular device or any particular type. The specifications are drawn so as to establish fundamental safety requisites, leaving to the carriers the selection of any device which will meet the requirements.

The act requires that such order be issued and published at least two years before the date specified for its fulfillment. The carriers requested additional time within which to make further tests and we allowed a further period of six months. In view of the additional time granted, the years of study and experimentation already devoted to the subject of automatic train-control, and the growing need therefor, it is expected that our order will be complied with promptly. Under our order the installation must be com-

Try Induction Devices—In addition to devices of the ramp type, a number of roads are now installing induction devices for test purposes. These are non-contact devices which depend upon the effects produced upon apparatus on the locomotive by magnets, or inert elements, placed between or outside the running rails. They are, like ramp-type devices, intermittent in their action; that is, impulses are transmitted to the locomotive from roadside apparatus only at certain selected points. Devices of intermittent type are generally devices to compel obedience to stop indications of fixed wayside signals or, where speed control features are incorporated, to compel obedience to caution indications of such signals by automatically bringing the train down to a predetermined safe speed.

The need for automatic train-control devices has been further emphasized since Jan. 1, 1922, by our investigation of six serious train accidents resulting from non-obedience to automatic block signals. These accidents resulted in the death of 50 persons and injury to 488 others.

Carrier Pigeons Aid Forest Fire Fighters

The U. S. Forest Service is experimenting with carrier pigeons as aids in fire fighting. In a recent test a pigeon was dispatched to headquarters from the scene of a fire, but before the relief party was organized a second pigeon reported the fire under control and assistance needless.

Changes in Mattamuskeet Drainage District, North Carolina

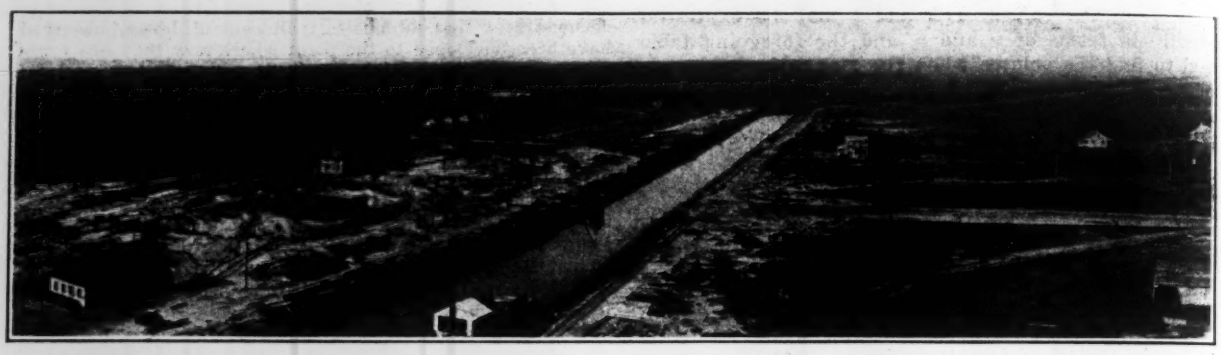
Project Refinanced, Levees Repaired, Canals Dredged, Pumps Overhauled and Railway Built for Better Transportation

By John R. Wilbanks
Consulting Engineer, The R. L. Dollings Co., Columbus, Ohio

THE bed of Lake Mattamuskeet is a shallow basin in Hyde County, N. C., lying between Albemarle and Pamlico Sounds, about fourteen miles long and six miles wide, containing 48,830 acres. The elevation varies from sea level to —3.9 and the soil is very fertile. (See U. S. Department of Agriculture Bulletin, "Soil Survey of the Lake Mattamuskeet Area, North Carolina," by W. Edward Hearn; May 16, 1910, p. 1.) The lands surrounding the lake have been in cultivation for more than two hundred years and in but few places is the elevation as great as 10 ft. above sea level. The first effort to drain this lake dates back to 1773 but no progress of consequence was made until about 1908 when both State and Government officials, appreciating the value of the property, used the resources at their command to aid private enterprise to develop the property. The technical features of the project were described in *Engineering News*, March 1, 1917, p. 346, with editorial comment on p. 365 of the same issue, while on March 29, 1917, p. 529, there appeared a letter by J. W. Dappert, criticizing the work. This article will review the recent history of the project and outline some extensive repairs and deferred maintenance work, and also the construction of 35 miles of railway to afford the district better transportation facilities. The total amount of water to be removed is about 8,300,000,000 cu.ft. per year and estimating that evaporation and plant growth will take up 40 of the 60 in. of annual rainfall, the pumping plant should handle the remainder in 54 days.

The writer first became acquainted with the project in the Fall of 1918 when he visited New Holland as a representative of financial interests who were contemplating the acquisition of the holdings of The New Hollands Farms, Inc., which company owned the 48,850 acres of land constituting the lake bed.

Refinancing and Reconstruction—It is easy to look back over work already begun or completed and pick flaws or offer criticism. The drainage of Lake Mattamuskeet would have been an ideal private enterprise with a boundary canal and levee surrounding only the lake bed proper and with a pumping plant of half the capacity of the present one. However, the district was already established and the problem to be solved was whether or not the plan could be successfully completed. A thorough investigation disclosed that the original layout had been well considered, and the improvements which had been made were with the idea of permanency. Perhaps the prime cause of delays and misfortunes was the fact that the project was inadequately financed and the various efforts poorly co-ordinated. The consequence was that in 1918 the lake was again full of water and the canals which had been dug were about 85 per cent filled with silt. The levees were leaking badly and the pumping plant had not been kept in good repair. Transportation facilities for an enterprise of this magnitude were entirely inadequate. The maintenance tax assessed was insufficient and in general the entire work had to be refinanced. Continuance of the enterprise was warranted by the fertility of the soil, the delightful climate, nearness to market and demand for the products.



PANORAMIC VIEW OF NEW HOLLAND TOWNSHIP AND PART OF MAIN CANALS
The view taken was from the top of a 125-ft. water tank and covers an arc of 180 degrees. Since the

The present owners of the property began work in the latter part of 1919. The pumping plant was put in first class condition, the levees were repaired and a 35-mile standard-gage railway (New Holland, Higginsport & Mount Vernon R.R.) was built from New Holland directly across the lake connecting with the Norfolk Southern R.R. at Venona, N. C.

This railroad was located for the purpose of providing all of Hyde and a part of Washington Counties with the most direct outlet for truck and similar produce to eastern markets. Nine miles of the line is on the lake bed, where a good foundation was secured; about five miles was across a savannah of black muck, where the track was laid on a mat of poles and later ballasted with sand, while the remainder is across lands which have already been reclaimed by gravity drainage districts. The section of the Inland Waterway connecting Albermarle and Pamlico Sounds crosses this railroad about halfway between Wenona and New Holland and its completion will aid materially in the transportation need of the community in general. The Foundation Co. of New York City was the contractor for the railroad. A gasoline truck and trailer was put in service on the railroad for the purpose of accommodating passengers, mail and express. It made one round trip daily and its performance was remarkably reliable and economical but the business soon outgrew its capacity although it now serves as an auxiliary and is very

effective equipment for any short line railroad to own.

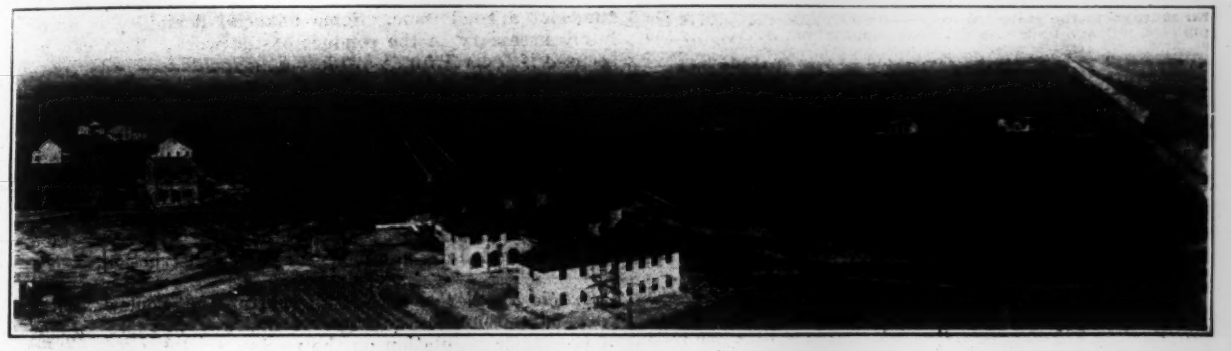
The present dredging equipment consists of one 12-in. hydraulic dredge and two 1-cu.yd. gasoline dredges. Water has been maintained at from 5 to 7 ft. below sea level without difficulty and, as severe weather conditions have existed since the work was completed, if there are any reasons why the district cannot be maintained they are not apparent at the present time.

Model Town—The town of New Holland is being built with modern cottages and equipped with sewers, waterworks and electric lights. It is proposed to sell the land to experienced truck farmers in small tracts and give them time to demonstrate that they can earn money on their land to pay for it, providing their efforts are constant and well directed. Farming is not a business in which people get rich quickly, and while it has been pretty thoroughly demonstrated that the soil in this district will produce more per acre at a less expense of lateral ditches, planting various crops and in general getting the property in shape for settlers to begin actual farming on their arrival.

The only comtemplated changes in the original plan are the possible gravity diversion of some of the rainfall on lands above sea level, and perhaps a change in design, but not purpose, of the various townsites.

Both "dry land" and floating dredges can be used to advantage in maintenance at the present time, but an electrically-driven hydraulic dredge of light draught, getting its power from the pumping plant, will no doubt be the most suitable for permanent use.

The new work was done under the supervision of the Service Department of The R. L. Dollings Co., Columbus, Ohio, of which Dwight Harrison is general manager and the writer is consulting engineer. K. L. Ponzer, New Holland, N. C., is chief engineer of the North Carolina Farms Co. The Board of Drainage Commissioners consists of D. H. Kirwan, S. S. Marshall, and the writer.



OF MATTAMUSKEET DRAINAGE DISTRICT, HYDE COUNTY, NORTH CAROLINA
view was taken a number of streets have been constructed and additional buildings have been erected.

either money or effort than any known similar soil, there is still considerable knowledge to be gathered concerning the most profitable crops to plant and how to market them to best advantage.

Community planning and developing must "feel its way" in a practical manner for several years to come, but the development will be rapid, as there is no grubbing or clearing to do. Ownership of land after all is only a chance and its moral value depends upon the use which is made of it. The continued success of the enterprise depends upon getting experienced settlers on the land and providing them with a direct market for their products.

Since the draining of the lake has been accomplished the company has been grading roads, putting in small

GASOLINE MOTOR CAR AND TRAILER
The equipment made a round trip of 70 miles daily with success until its capacity was outgrown. It still serves as an auxiliary.

Desired Data on Multiple Arch Bridges

Facts on which to base the design of concrete multiple arch bridges are meager, especially for structures having relatively tall piers. The Engineering Foundation states that some months ago A. C. Janni proposed that it organize a co-operative study of such structures, involving tests of experimental arches and piers built for the purpose. The Foundation sought the counsel of the Advisory Committee on Civil Engineering Research, which reports that it believes the study to be important and desirable but extensive and probably very costly. If support for the project should develop and it should be undertaken, a natural beginning would be observations on existing bridges. Private parties have attempted some measurements on a large bridge of this character. In another bridge, preparation was made for observations, and some measurements may have been taken. There may be other cases. Engineers who have knowledge of such data are requested to inform the Foundation, at 29 West 39th St., New York. Expressions of opinion as to the usefulness of the proposed investigation and information about existing bridges on which observations could be made would also be helpful; also information about deformations and stresses in such structures caused by shrinkage of the concrete, temperature and moisture changes, settlement of foundations, and effect of removal of forms. These factors may be more important than loads.

Financing the California State Highway System

Commission Estimates $135,000,000 Additional Funds Required — Seven Recommendations Made—Traffic Control Urged

Abstract of the annual report of A. B. Fletcher, who has just retired as State Highway Engineer of California

WHILE the great activity in highway construction during the past two years has given the state the service of a large new mileage of improved road, it has also brought California face to face with the problem of refinancing its highway system.

Money Needed—How great an amount of money could be advantageously spent upon California's road system is indicated by the mileage now in the system and the character and cost of the portion that has been improved as compared with the mileage yet to be improved. The figures are as follows:

Total mileage in the state highway system	6,400
Completed mileage under bond issues (approximate)	2,500
Mileage still to be improved (exclusive of graded roads included in the improved mileage above, but some of which are yet to be paved or otherwise further improved)	3,900

The following tabulation shows the mileage of bond issue roads constructed or improved:

	Miles
Earth and gravel	701
Asphalt macadam	64
Topeka on macadam	16
Portland cement concrete bases	1,567
Asphalt surface on concrete base	108
Miscellaneous	10
Total	2,556

The cost of the completed bond issue roads has averaged approximately $20,000 per mile. The average cost per mile of improving the remaining roads in the California state highway system, however, will probably be not less than $25,000 and may be considerably more than this amount, depending entirely upon the class of improvement adopted.

Most of the work to date on the system has been in the valley or hill sections of the state where the grading was comparatively light and pavement costs were relatively low, due to close proximity to rail facilities. By far, the greater part of the grading yet to be done is in mountainous country.

At $25,000 per mile the cost of improving 3,900 miles will amount to very nearly $100,000,000, but this amount does not represent the total expenditures that must be made on California's highway system. It represents simply an estimate of the cost of improving to average specifications of past years the unimproved portions of the present state highway system, and the reconstructing of the old county-built macadam roads in Los Angeles, San Joaquin, Sacramento and several other counties, which have become a part of the state highway system.

To this must be added the cost of widening and thickening approximately 1,200 miles of the present system and the elimination of grade crossings. These two latter items will cost about $35,000,000 additional.

Work in sight at the present time will, therefore, cost not less than $135,000,000 to complete.

It should be noted that the above statement includes only items involving capital expenditures. Money for maintenance must be provided outside of this sum.

Methods of Financing—Three methods of financing highway construction have been analyzed: (1) Construction on a pay-as-you-go plan, (2) construction on a bonding or deferred payment plan, (3) construction on a plan based in part on direct payments and in part on bonds. As a result of a careful study of these plans the commission has reached certain definite conclusions relative to highway financing. These may be summarized as follows:

1. The demand for roads is so insistent that the public will not be content to await their construction on the slow process of pay-as-you-go plan. Correlated with this is the demonstrable proposition that improved roads pay their own way with a handsome return on the investment and hence an investment in good roads is a paying venture for the people of the state.

2. While another bond issue appears to be imperative, the users of the roads should be asked to bear a larger share of the highway burden than has been placed upon them in the past.

3. Future bond issues should not contemplate providing funds for the completion of the entire system. The public should realize that the completion of the state highway system is many years in the future and that as California grows, its road system must grow with it. Disappointment can only follow any bond issue which the people are asked to vote with the promise that it will be the last one.

4. The preferable method is to ascertain the amount of work that can be economically and efficiently undertaken by the California Highway Commission in any one year, and under normal building conditions. With this ascertained, the work should then be financed for a period of not less than five years.

5. Such a plan would require a rigid budgeting of the funds of a bond issue. Some financial flexibility is absolutely necessary in the conduct of the work. This can be secured if federal funds are left unbudgeted.

6. The gasoline tax and an increase and equalization of the motor vehicle fees offer a practical and fair method for imposing a larger share of highway costs upon highway users.

7. The legislature should definitely and rigidly refuse to designate roads as state highways unless at the same time finances for their improvement and maintenance are provided; nor should any roads be included in a bond issue except upon definite allotment for their construction.

Traffic Regulation—No less important but somewhat less perplexing than the question of highway finances is that of the traffic regulation on the roads.

It is the opinion of the Highway Commission that the present maximum weight of 30,000 lb. permitted upon the state highways should be decreased to a maximum permissible gross weight of 22,000 lb. This latter weight will permit the operation of the five-ton truck and its load.

Experience has demonstrated that the mere passage of a regulatory law is useless unless machinery is set up for its enforcement. The Highway Commission recommends the establishment of an adequate force of state motor police to enforce traffic laws on state highways. It is the opinion of the Commission that such officers should operate under the direction of the Highway Commission for the reason that the body charged with the responsibility of maintaining highways should be vested also with power to adequately protect them.

The Commission would also recommend that there be written into the law of California by the next legislature the so-called "Maryland Plan."

This plan has been found the most effective method yet devised for stopping overloading, inasmuch as under it the operator of a truck found with an overload can be forced to remove it before proceeding farther on the highway. Once forced to leave a portion of his load by the roadside, there to incur the risk of damage through the elements or loss by theft, and the further expense of sending a truck back for a small cargo, operators are careful to avoid future overloading. Recommendations for traffic regulation may be summarized as follows:

1. The maximum permissible weight on state highways should not exceed 22,000 lb.

2. An adequate force of state motor police should be authorized for the enforcement of traffic laws on state highways.

3. The police should be under the authority of the State Highway Commission, the body responsible for the protection and maintenance of highways.

4. Where portable scales reveal that a truck is overloaded, traffic officers should be authorized to demand the removal of the excess load before the truck proceeds on the highway; the so-called Maryland plan.

Concrete Bridge a Continuous Beam on Hinged Piers

War-Time Structure for French Steel Plant Also Has Approach of Novel Box Retaining-Wall Type

DURING the war there was built at a steel mill at Saint-Chamond, France, a long reinforced-concrete viaduct of exceptional novelty in design. Only in a recent issue of *Le Genie Civil* has there appeared any description of the structure, and from that description there has been prepared the following account:

The viaduct carries the service railroad of the plant across a valley which is traversed by other tracks on grade and filled with buildings. Because of the restrictions of both line and grade, the latter to gain clearance and to provide safe travel for the service trains, it was necessary to lay out the new viaduct on a slight curve, to spot its piers at odd intervals and to provide a minimum depth to the spans. In order to answer these requirements and at the same time take care of expansion, reduce breaking stresses and effect economies in reinforcement, it was decided to make the main crossing a continuous beam carried on hinged piers and abutments. The approach is a series of concrete cells filled with earth.

As shown in Fig. 1, the total structure is 764 ft. long, of which 62 ft. is a small approach single span, 283 ft. at one end and 31 ft. at the other end retaining wall, and 390 ft. the continuous-beam viaduct. The viaduct comprises seven spans, varying from 39 ft. to 94 ft. In section, as shown in Fig. 3, the girder is 6.6 ft. wide and 7.2 ft. deep with 6-ft. 2-in. cantilevered brackets. It is reinforced with a number of small rods at the bottom, together with a series of longitudinal spirals in the lower part of the section and with the usual cantilever reinforcement for the bracket. It carries in its center a 4.9 ft. gage track (1½ m.). Vertical reinforcement consists of diagonal stirrups as shown. Each span is

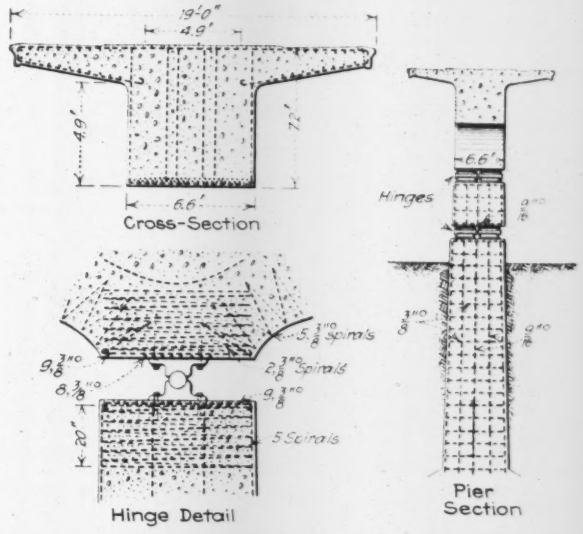


FIG. 3—DETAILS OF MAIN GIRDER AND HINGED PIER

corbeled at the supports and extra reinforcement in that section is provided by spirals as shown in Fig. 3.

This pier consists of a solid section through its spread bottom to a point just above the earth surface. Between this pier and the beam supports there is an intermediate pier with hinges both above and below, as shown in the section in Fig. 3. These hinges are of steel on steel pins. One pier in the middle of the viaduct is an abutment pier, much wider than the others and carries only one hinge. It will be noted, however, that the abutments are both two-hinged.

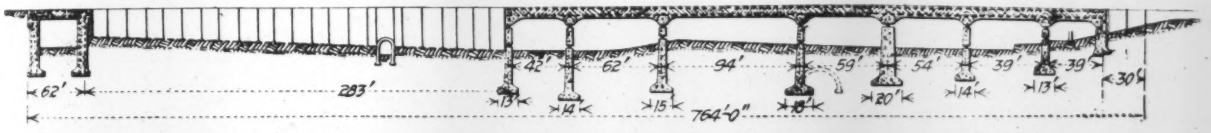


FIG. 1—LONGITUDINAL SECTION THROUGH NOVEL FRENCH CONCRETE BRIDGE

Main structure a continuous beam on piers which are double hinged, except anchor pier which has only one hinge. Approach is box retaining wall and small bridge at left end is solid slab with pivot support.

The retaining wall is made up of a number of cells of details as shown in Fig. 2. There are walls of varying thickness, but averaging around 8 in., sloped slightly inward and with cantilever brackets outward at the top. They have a spread footing at the bottom and are cross-braced with 6-in. walls. This section was built on an old slag fill of a number of years' standing.

The bridge is designed for very heavy loads. According to the statement in *Le Genie Civil* it has to resist a speed of 12 km. per hour (9 miles per hour), two types of load: one, a locomotive of 50 metric tons pulling a special car of 200 metric tons load, with four axles of 1.1 m. to 1.75 meters, and a total length of 5.5 meters; the other, the same locomotive followed by an indefinite number of cars of 65 metric tons each. Special attention is paid to wind stresses and braking stresses. After the construction the bridge was tested to the full design load with quite satisfactory results. It was found, for instance, in the longest span (95 ft.), where there should have been a theoretical deflection, considering the tension in the concrete, of 8.25 mm. and of 11.25 mm. without considering the tension, that the observed deflection was 9.9 mm.

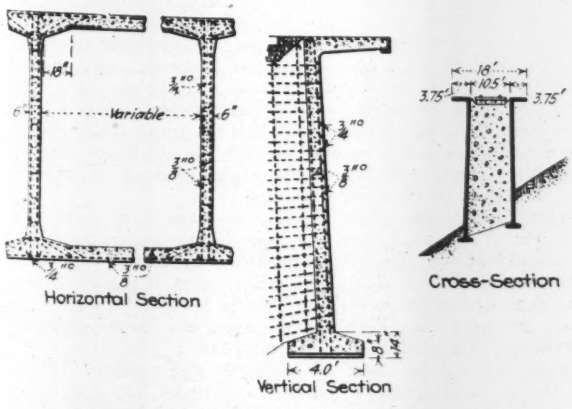


FIG. 2—DETAILS OF BOX RETAINING WALL

Fundamentals of Highway Department Organization

Address Before the Association of State Highway Officials Urges Leadership—Ability to Sell Highway Improvement to the Public Is Paramount

By A. R. Hirst
State Highway Engineer of Wisconsin

IF WE investigate American highway history we find practically without exception that those states which have made distinguished successes of their highway work, have done so because the work was controlled by a body or person permitted to function over a series of years without political dictation or interference. Conversely, we find, almost without exception, that in states where a new governor invariably means a new highway administration highway progress has been slow and unsatisfactory.

In a work where length of service, experience and knowledge of past history is as essential as it is in the highway field, the control of the work should not be subject to instant change with every political change, but should be as far removed from the domain of politics as it is possible to place it and yet make the administration of highway matters properly responsive to the taxpayers.

The body acting as the board of directors of a state's highway work should be a long term body, appointed from time to time by successive governors, so that no single governor, unless elected over a term of years, could control the state highway department. This body should consist of a practically non-paid state highway commission composed of high class men serving because of their interest in highway work, and in public service, and not because of the emoluments. It has been found possible in every state which has tried it, to find strong men to serve and serve well on the highway board of directors, provided too much of their time is not required.

The state highway body should act as a board of directors, determining the principal policies, and selecting and employing the executive officer and holding him responsible for the success of the work. In this way the executive officer is removed one place from direct contact with politics, and is free to prosecute the work of highway construction and maintenance without political embarrassment.

Manager of the Enterprise—Every effective organization has a head—a single head. Most enterprises have boards of directors, or the equivalent, but in the final analysis, every enterprise has one man who is held responsible for the success of the enterprise.

This must also be true of highway work. The enterprise must have a single manager or executive. Whether this executive or manager is appointed by the governor, elected by the people, or appointed by a board or commission, is immaterial as long as longevity of service is insured to the successful manager. Length of service as a reward for good work is made much more sure for the manager who is appointed by a board or commission, in turn appointed by the governor, than in any other way. The history of highway departments demonstrates that this is true. We believe that the states will not be well organized to perform their highway functions until this plan of organization is universal.

Whether the appointee should be a highway engineer, or a high class professional or business man not an engineer, is debatable. I am enough of an engineer to believe that when there is the uniting of the proper qualifications in an engineer, he makes the ideal manager of a state highway enterprise. But the combination of the proper business and managerial ability with the proper amount of engineering ability is not universal in engineers, and the present American tendency to appoint a non-engineer as the executive controlling the general phases of the work, while a chief engineer is employed to have charge of the engineering, may be the solution in many cases.

It is undoubtedly a good solution wherever a big man, not an engineer, and who realizes he is not an engineer, is employed as the manager. But in too many cases the moment a successful lawyer, farmer, or business man steps into the chief highway chair, he becomes an expert highway engineer in the twinkling of an eye, and rules the roost from top to bottom, without having the necessary background, education or engineering qualifications to do so.

However, an effective state highway board or commission can regulate the division of responsibility as between the instruments which they believe it advisable to employ. If the board or commission realizes the line which must be drawn between the executive management of the enterprise and the control of the engineering phases of it, the work will succeed regardless of whether the man at the head is a good highway engineer or a good general executive.

The Subordinates—The field of highway engineering, due to the romance of it and the fact that it has become within a decade probably the largest employer of civil engineering talent in America, has attracted a very high class of young men. These young men, not knowing very much about the political situation overhead, have come into the game with pride and enthusiasm. They want to make good, they are capable of making good, and they will make good, if those of us who are responsible for the conditions under which they work can create the right kind of organizations for them to function and expand in.

These young men—our successors—have had, most of them, better training than we had. They enter the field after many of the elementary problems have been met and overcome, and they should become better highway engineers than any of us have been able to become. Two much stress, however, has been placed upon the importance of engineering knowledge and training as a preliminary to work in the special field of highway engineering. Universities and colleges can produce scientists, but God only can produce men of natural adaptability and brains.

Essentially the business of building the American high-

High Points in Mr. Hirst's Address

There are some 15,000 highway engineers, not including the thousands of county and municipal officials, who need to know something of highway problems.

All of these men have received their training in the last 30 years and infinitely the greater number of them in the past 10 years.

One of the chief problems of highway administration is to organize these men into permanent, efficient, loyal bodies for highway development.

Each state organization should consist of a non-paid highway commission, acting as a board of directors.

A single executive should direct the work, and whether this manager is appointed by the governor or the commission or elected by the people is immaterial as long as longevity of service is assured the successful manager.

Essentially the problem of building the American highway system is not a problem of engineering but a problem of handling people in detail and in mass.

In selecting men for highway work look first for personality and second for technical knowledge.

To secure and retain clean-cut, energetic and progressive men it is necessary to pay salaries adequate to the work.

Unless a state highway department can sell and does sell its ideas and its ideals to the people, it fails to perform its greatest function.

way system is not a problem of engineering, but a problem of handling people in detail and in mass. Humanness is the big factor in the game. The ability to impress one's own viewpoint while not insulting the man who holds another is a prerequisite. We must deal in county highway work with county boards and with the residents of the county; in state highway work with the legislature and with the whole people of a state. No matter how profound our learning, how inclusive our experience, or how well founded our conclusions, if we cannot put our ideas and ideals across and get the support of the legislatures and of the people of the unit of government which employs us results cannot follow.

It is my conviction after a highway experience of twenty years that the first thing to be sought in employing a highway man is personality and likeability. There will of course need to be down in the lower registers scientists without number, but these are not the men who will leave their impress upon the highway thought or upon the highway progress of America. In selecting men for service in highway departments look first, for personality and second, for knowledge. Personality without knowledge is of little avail, because the American people are quick to see through pretense and bombast in their employees. But, on the other hand, knowledge without personality, except in those positions close to the bottom, is just as useless. Highway executives should not lose sight of the human equation, which is the only factor that really counts.

In all times to come, the administrative highway official will have to get the funds for his program out of the people through their legislative bodies. He must be an advertiser and a seller of his goods. He must be a promoter of parts, able to get out a prospectus and to make a sale, and he is selling not one person but millions of them. We want in this field young men of education, of promise, of courage,—men who really belong. The half-dead-and-alive ones, who would not know a football yell from a cradle song, belong behind the drafting desk, pushing a right line pen or chaperoning a planimeter around cross-sections.

The Matter of Salaries — We have stated that we need clean-cut, energetic, up-and-coming organizations. The only way to insure these is to pay salaries adequate to the work. There has been a considerable increase in the salaries paid by American highway departments. The proper standards have not yet been reached, but if the next five years show the same progress that the last five years have recorded, proper salary scales will have been established.

The great difficulty in establishing proper salary scales in the average state is that the whole scale of public salaries is too low. When the governor of a state receives a salary of $5,000 a year, it is hard to convince the people of the state that the head of any state department should receive more than the governor. However, it is being done in many of the American states, and it must be established in more of them if real success in the highway program of the state is to be secured. The salary paid the executive head of a highway department is supremely important because his scale dictates the scale of all below him—well paid head, well paid department, and vice versa.

The highway field is a highly competitive one. There are a number of allied and supplementary branches which appeal to the engineer as profitable and attractive. If the state highway departments are to hold their best young men they must convince them that they have at least as much to offer as have other branches of the business.

The only other large employer of civil engineers has been the railroads. Their scale of salaries has been comparatively low, but they have kept a very high class personnel in their engineering forces, simply because there were positions higher up, well paid and even magnificently paid, to which the young engineer could aspire.

We must establish approximately the same conditions in the highway engineering field if we expect to hold the best of our young men. If the higher positions, paying the money, are always to be held by politicians and political appointees, we are going to create a very discouraging situation for the up and comers down below.

One discouraging factor in the situation is, that many fine men interested in highways who have made their stakes in other enterprises, are entering the highway field and accepting without protest any salary offered them simply because the salary they obtain from their highway work is not a factor in their personal situation. They wish to perform a public service and are willing to do so at any salary because they have made their stake.

We are very glad to see them enter the work. They should realize, however, that while highway work may be the plaything of a few years to them and means nothing as to their financial success in life, the highway field is the field of life performance for thousands of other men who expect not only to make a decent living out of it, but hope finally to amass a reasonable competence for old age.

Selling the Ideas—All of us must sell our ideas and our ideals to the national and state legislatures. The county highway administrator must sell his ideas and ideals to the county board. These are delicate and important tasks.

Unfortunately about three-fourths of the political campaigns of America are carried on, with all participants pledging themselves to economy and efficiency in the operations of whatever unit of government they aspire to represent. The conception of the great majority of these men as to economy and efficiency is that it will be best promoted by cutting down on the amounts spent for overhead. They believe, almost without exception, that the body politic will function much better if some of the members are amputated. Consolidation of departments, and elimination of departments has a public appeal, only second in effectiveness to promised curtailment in the funds appropriate to operate those departments which are to be allowed to continue to exist.

Economy and efficiency are considered sister words to lack of expenditure for overhead. The reduction of fifty thousand dollars in the cost of operating a well managed state highway department is hailed as a master stroke of economy when, as a matter of fact, it is usually the very acme of wastefulness, leading to abuse and looseness in the expenditure of the vast highway funds available.

The average state legislature or the average county board would not deliberately cripple or make less efficient any branch of the state and county service, but it has so long been in the blood of the American people that the less public servants they have, the better their pocketbooks are protected, that it is difficult to eradicate the idea.

The national bill for rural highways now totals approximately $750,000,000 a year. The expenditures of many of the larger states for rural highways are over $20,000,000 per annum. Those large states which have not reached this total will soon approach it. In the expenditure of sums of such staggering magnitude only the best talent should be employed. Where it does not exist it must be made. The state which first gets and keeps a highway organization, composed from top to bottom of men with knowledge, brains, experience, energy and foresight is going to get the cheapest highway service, regardless of the amount of money spent in operating its highway departments.

Unfortunately, too many highway officials despise work with the legislatures and with the county boards. They consider it beneath the dignity of their profession to mix with politicians. But as long as the American government is organized on a political basis just as long will state, county and city employees have to do business with politicians. That, of course, means as long as the American government shall endure.

The American politician is not, in general, either vicious, ignorant, or unpatriotic. He, however, changes often, and he cannot know the highway situation in our state as we should know it. It is one of our duties to help him to know it, and the dodging of that duty and responsibility makes impossible the performance of the service which we should give our people. A state highway department is not a real department unless it can make definite proposals for legislation, help to frame those proposals into bills, and then help to pass those bills. The department which takes what it gets, gets little. Neither do the people of this state get real highway progress or service.

FROM JOB AND OFFICE

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Plotting Transit Lines by Natural Tangents and Cotangents

BY FRANCIS R. MOLTHER
Brooklyn, New York

WITH the object of employing a system of the greatest expediency reconcilable to sufficient accuracy, the following method of plotting long transit lines was developed on a recent railway location job in Colombia. The general method consisted in plotting all courses by the employment of the natural tangent or cotangent of the angle deflected by each course from a predetermined meridian.

The meridian should be laid off on the sheet in the most desirable manner, as indicated by the size of the sheet or the space available for the map, and the general direction of the survey. Normals should then be erected or dropped from this meridian as required by the length of the courses to be plotted, and the general deflection of the courses to the right or left of the meridian.

Then, at some convenient decimal scale, a distance to be considered unity should be measured to the left of the intersection of the meridian with the normal, along the line of the meridian, to give a base point for locating the azimuth of all courses measured by tangents on

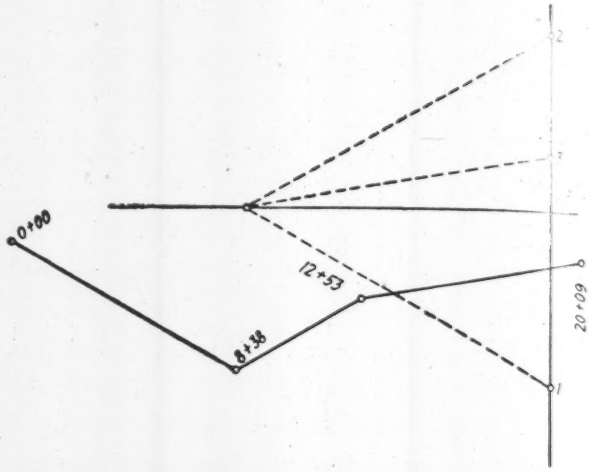


FIG. 1—LAYING OFF TANGENTS ON NORMAL TO MERIDIAN

that normal. The tangent of the first course should now be laid off at the same scale along the normal to the meridian, up from the meridian if the deflection of the course to be plotted is left, or down if the deflection is right.

Any number of courses may be laid off on this normal, their length only determining when it may be desirable to move up to another normal. For reference, the points on the normal located by so measuring these tangents may be numbered 1, 2 and 3, etc. for the first, second and third courses.

Selecting some convenient point for the first hub the direction of a line through the base point and point 1 should be paralleled over, by means of triangles or parallel rulers, to pass through the point selected for the first hub. This line is the true direction of the first course, with reference to the meridian, and its length may now be measured at the scale selected for the map, locating the second hub. Repeating this process will locate all of the courses. Figure 1 shows the plotting of the survey line at this stage, complete to Hub 3 (Sta. 20 + 09).

Where deflection angles greater than 45 deg. are encountered, the natural cotangent of the angle must be employed, laying it off along the meridian, and measuring the distance unity on the normal. Deflections greater than 90 deg. must have that angle subtracted from them, and the tangent or cotangent of the angle remaining employed inversely for deflections of less than 90 deg. That is, where natural tangents are laid off on the normal and the meridian base point employed for angles less than 45 deg. when the angle is between 90 deg. and 135 deg. (less than 45 deg. when 90 deg. are subtracted), the tangent will be measured on the meridian and the base-points on the normals employed. Figure 2 presents a chart and sketch indicating the proper position for laying off and determining deflections of angles from 0 deg. to 180 deg.

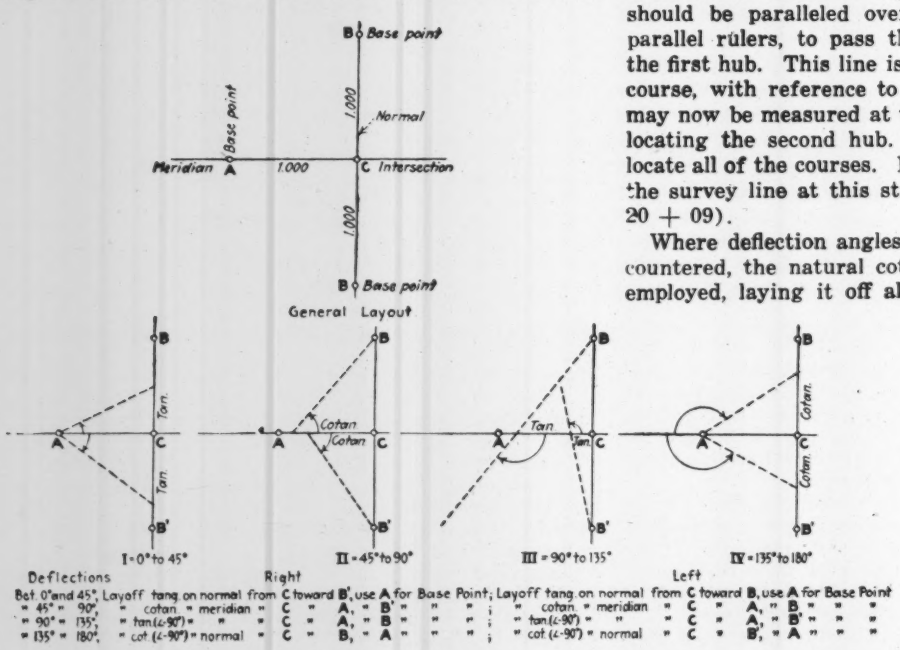

B Base point
Base point
1.000
Normal
Meridian A
1.000
C Intersection
1.000
B Base point
General Layout
Tan.
Tan.
Cotan
Cotan
Tan
Tan.
Cotan.
Cotan.
I = 0° to 45°
II = 45° to 90°
III = 90° to 135°
IV = 135° to 180°
Deflections
Right
Left
Bet. 0° and 45°, Layoff tang on normal from C toward B', use A for Base Point; Layoff tang on normal from C toward B, use A for Base Point
" 45° " 90°, " cotan " meridian " C " A, " B' " " " ; " cotan " meridian " C " A, " B " " "
" 90° " 135°, " tan (∠-90°) " " " C " A, " B " " " ; " tan (∠-90°) " " " C " A, " B' " " "
" 135° " 180°, " cot (∠-90°) " normal " C " B, " A " " " ; " cot (∠-90°) " normal " C " B', " A " " "

FIG. 2—PLOTTING ANY COURSE FOR DEFLECTIONS FROM 0 DEG. TO 180 DEG.

The occasion for which the writer adopted this method of plotting was for the drawing of the detail maps for a railway survey in Colombia, some 300 km.

in length, and generally northeast in direction, but with sharp breaks of several kilometers required by various developments in directions nearly normal to the general direction of the line. The line was completed with about 5,000 stations. The courses between each two hubs varied in length from 4 m. to 7 km. depending upon topography.

The great number of stations to be plotted recommended the use of some system more rapid than computation of latitudes and departures. At the same time a method as accurate as the use of co-ordinates was required.

The application of the general method outlined above was first to determine by means of a small scale chart, the meridional components of each course. The latitudes and departures of those hubs which were at the points of sharp changes in direction were then determined, and plotted at 1:10,000 scale. A meridian was now fitted through this skeleton of the survey, with the object of planning to incorporate as much of the survey in a single stretch as possible.

This first sketch also indicated the last hub which could be contained on this sheet, and the next step was to refer all the courses, between that hub and the first one accommodated on the sheet, to the selected meridian. This was done in the transit book. This computation was checked before proceeding, by subtracting like deflections, and adding unlike deflections, to arrive at the original deflection at the hub as contained in the notes. Incidentally, this check also afforded a further check on the transit notes, and caught several compensating errors occurring in pairs on the same page that had prevented the original check of the page. To these data in the transit book, was added the natural tangent or cotangent of each deflection, or the deflection less 90 deg. where required, as explained previously.

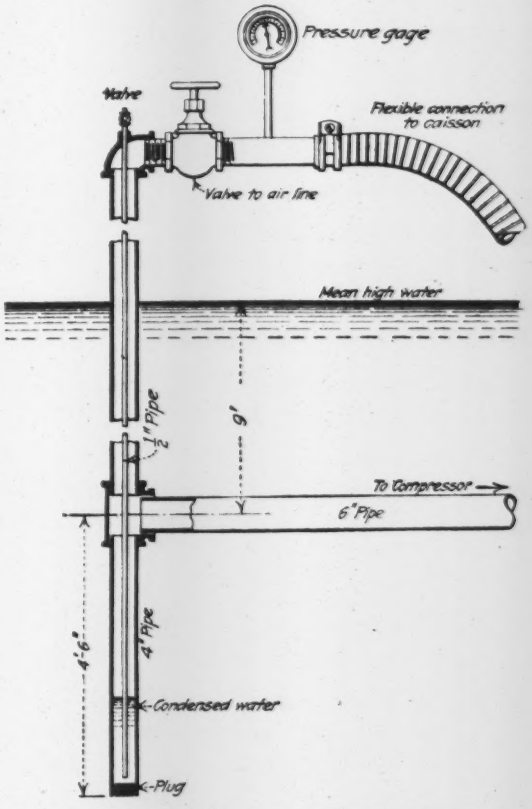
The scale for all detail maps was 1 : 2,000 (metric), drawn on rolls 48 in. wide, making the sheets as long as the undulations of the survey would permit. A straight line was carefully drawn down the middle of the sheet, and assumed to be the same azimuth as that selected for a meridian from the preliminary sketch made by approximate latitudes and departures. On this line normals were erected every 500 m. at the same scale (1 : 2,000) as that to be used for the map. On each normal, employing that section of the meridian between each pair of normals where necessary, the tangents or cotangents on one page (usually 12 to 13 courses) were measured. Occasionally the length of all the courses on one page would prove so short, that the same normal, and section of meridian, would be employed twice, or the courses would prove so long as to recommend skipping several normals before measuring the tangents and cotangents of the next page. The location of the first hub having been determined by the preliminary sketch, the courses, were now paralleled over to the respective hub where each started, and the length of each course scaled. As each course was paralleled, before its length was measured, the true deflection at the hub was checked with a protractor, which with a little practice could be read to 5 min. As each page of the transit book was mapped, the plotting of the distances was checked back.

This method is claimed to offer equal accuracy with that of latitudes and departures, when the advantage of the above opportunities for checking deflections and distances is employed.

Blowing Out Condensed Water in Air Line

WHEN the caisson for the Camden pier of the Philadelphia-Camden suspension bridge was being sunk the temperature of compressed air was so high as delivered to the caisson that the line had to be sunk in water in order to cool the air. At times the temperature would attain 150 deg. F., making work unbearable. Accordingly, the 6-in. compressed air line was set about 9 ft. below mean high water. The length of the line from the compressor to the caisson was about 1,400 ft., 500 of that amount being submerged.

Though air was cooled sufficiently in this fashion water condensed in the line, creating another difficulty.



CONDENSED WATER BLOWN FROM SUBMERGED AIR LINE

Inasmuch as the line was submerged the "blowing out" of the line could not be accomplished in the usual fashion. A simple device, illustrated herewith, was conceived by the man in charge of compressed air work to "blow out" the line.

At the caisson end of the line instead of a 90-deg. bend being put in the pipe to bring it from the water a sleeve was inserted and a 4-in. pipe run both ways. The stub end, which projected farther into the water, was plugged. Through it and the pipe which projected from the water and to which was attached the flexible connection running to the caisson, a ½-in. pipe was run, being well packed where it projected from the 4-in. pipe. A blow-off valve was fitted into the ½-in. pipe.

When the water condensed it collected in the stub pipe. When it was apparent that sufficient water had condensed to void the pipe, the valve in the ½-in. line was opened and the air pressure in the air line forced the water out.

High Viaduct Moved 75 Feet Laterally

By Edward Godfrey
Structural Engineer, Robert W. Hunt & Co., Pittsburgh, Pa.

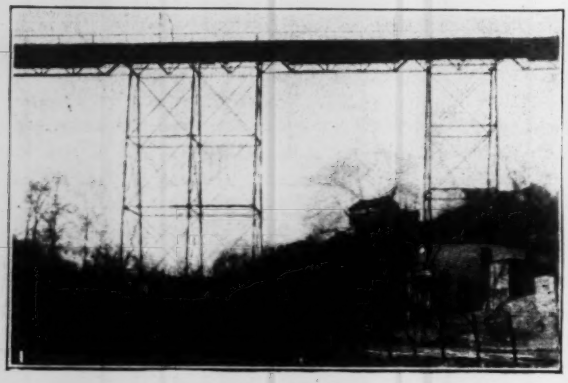
A SPECTACULAR engineering feat was performed in Pittsburgh recently when a high viaduct 740 ft. long was moved sideways bodily a distance of 75 ft. to make room for the building of a reinforced-concrete arch bridge.

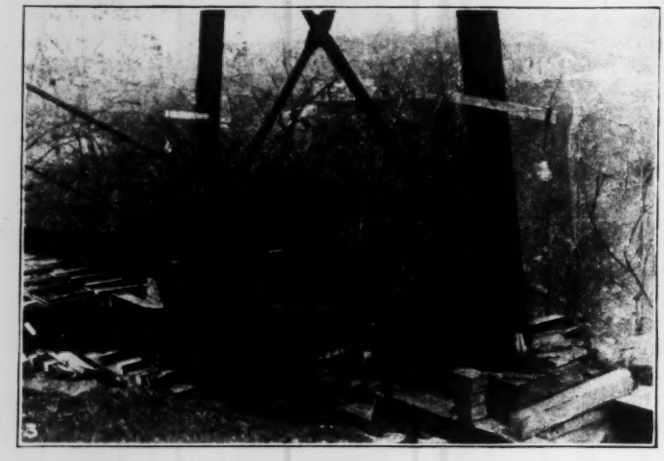
The viaduct is located on the line of the Pittsburgh Railways Co. to Bellevue, a borough adjoining Pittsburgh. It spans the deep hollow of Jacks Run; in its highest portion its floor is about 150 ft. above the bottom of the hollow. It was built about 28 years ago and has since carried the trolley tracks and a highway.

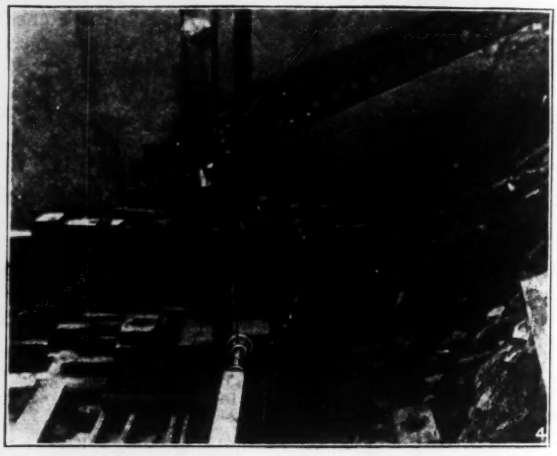
Some years ago the lattice girders supporting the floor system were reinforced because of rusting and heavier trolley loads. Before the work of moving the bridge was undertaken, the writer made an examination and discovered that the top flanges of the stringers were very badly rusted away, and further reinforcement was needed. The floor system was, therefore, strengthened by the addition of floor beams at the mid-panel points.

Because of the great height of the structure, the question of the overturning effect of wind was one of the main features that required attention preparatory to moving. It was dealt with not so much by theory or calculation as by the history of the bridge. Examination of the anchor bolts and bases of the posts showed that the bolts penetrated only the base plates, so that their value was only that of tension on the rivets connecting the angles with the shafts of the posts, and in addition that these bolts (which subsequent operations revealed were good, long bolts, well bedded in the stone caps) were practically devoid of nuts. What nuts had been put on were not drawn up. Some of them lacked three inches of being in contact with the plates. This was a very general condition, being true in particular of the highest towers. In view of the evident uselessness of the anchor bolts and the fact that the bridge had weathered the storms of more than a quarter of a century without any evidence of negative reaction on the bases of the posts, it was considered safe to cut it free for one day while it was being moved, without loading down the columns.

The viaduct is carried on thirteen bents. The spans in the towers are 30 ft.; other spans vary from 48 to 96 ft. The trusses are 8 ft. deep and are of the Warren type, with vertical posts at floor beams. This arrangement afforded opportunity to introduce the extra floorbeams at the upper panel points where the diagonals meet.







JACKS RUN VIADUCT PLACED ON ROLLERS AND MOVED TO A NEW SITE ALONGSIDE

Fig. 1—Highest part of viaduct about 150 ft. above ground.
Fig. 3—Timbers and channels under the pier cap stone transfer the load to the rollers.
Fig. 2—Clamping beams around the pier cap stone used for jacking up and needling a tower.
Fig. 4—Screw jack pushing against the tower-leg blocking.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

FROM JOB AND OFFICE

For Contractor and Engineer

While preparations were being made for moving the bridge, new concrete pedestals were constructed on the new site of the bridge, and abutments were built up of cribbing and earth fill. The trolley tracks were laid on these abutments so that cars could be run on the bridge as soon as it was moved.

The accompanying views show some details of the moving arrangements. The support of two of the posts may be seen in Fig. 2. In the case of the post on the right, large I-beams were bolted on the side of the top stone of the pedestal. These beams were then jacked up and the second stone was broken up and removed, permitting the placing of needle beams under the heavy I-beams and under the cap stone, wedged against the cap stone. In all cases direct bearing of the stones under the posts was secured, either through needle beams or through timbers placed directly under the stones. The base at the left in Fig. 2 was handled somewhat differently. The second stone in the pedestal was picked up by means of I-beams and the one below this was broken out. The heavy I-beams as well as the needle beams were used to carry load to the rollers. Under both of these posts the load was delivered to channels laid flatwise, bearing on the rollers. Fig. 3 shows a case where timbers and channels laid flatwise were placed under the stone.

How the timbers and channels were placed is made clearer by Fig. 4, which also shows how the bridge was moved by jacks. Not much force was required to push the bridge along. In fact, after the work was started it was found that one end of the bridge and an intermediate bent needed no urging but moved along with the rest of the bridge, and no jacks were used at these points.

The rollers moved on rails supported on timber cribbing which rested on sills laid on the earth. The posts shown in Fig. 2 had double sets of rollers and double tracks, those shown in Figs. 3 and 4 had single tracks.

Several lines of electric conduit carried by the bridge were taken care of during the moving of the bridge by flexible connections, to maintain service.

The anchor bolts were burned off just before starting to move the bridge.

About six weeks of preparation were required before the bridge was ready to be moved. It was anticipated that one day would be required for the 75 ft. shift. Moving was begun on the morning of Nov. 24, and the bridge was in its new position about 9 or 10 o'clock at night. Cars were run over the bridge on regular schedule the next morning shortly after 10 o'clock; the delay was due to the fact that some truss reinforcement and shoring had to be done that morning at the extreme ends of the bridge, which required several hours of daylight.

Transit observations for alignment and level during the moving of the bridge showed very little deviation. The writer examined the steel, particularly at points over bents, and no fresh paint cracks could be discerned, showing that the steelwork was not racked in the process.

Foot traffic was not interrupted during the moving of the bridge. A large number of people walked across for the novelty of the thing.

When the viaduct was in its new position, brickwork was built up between the concrete pedestals and the masonry blocks that had been carried over with the several posts.

The moving was handled by the John Eichleay, Jr., Co. Ernest W. Niederberger is their engineer. W. C. Boyd is engineer and J. S. Martin structural engineer for the Pittsburgh Railways Co.; W. C. Wymer had charge of the instrument work; the writer was consulting engineer for the company as structural engineer for Robert W. Hunt & Co.

Almost 100 truckloads of equipment, including 300 jack screws, 400 steel rollers, a mile of railroad rails, 150,000 ft. of timber and cribbing and 100 tons of steel I-beams were used in executing the job.

Model Constructed to Clarify Contested Points in Street Intersection

By F. S. Besson

Major, Corps of Engineers, U. S. Army, Assistant to the Engineer Commissioner, District of Columbia

IN EXCEPTIONAL cases considerable expense is justified in constructing models to make sure that the best possible street intersections are obtained. The figure herewith illustrates a model of the new George-

ONE-EIGHTH SIZE MODEL OF STREET INTERSECTION

The model was built mostly of sand containing some cement to depict clearly the possibilities of securing an easy railway turnout from the Georgetown Bridge approach to an intersecting street.

town bridge approach at its intersection with one of the city streets in the District of Columbia. The street is on a 3½ per cent down grade and the bridge approach on a 3 per cent up grade. The model, which is on a one-eighth scale, was necessary in order to co-ordinate the three interests involved: bridge, railway, and highway. Several other schemes were at first considered, all requiring a large bridge approach area with expensive track construction separated from the vehicular roadway, because prior to the construction of the model it was not evident to all that a satisfactory simple turnout, as illustrated, from the highway to the bridge, could be effected.

The model was constructed with sand, the curbs and rails of light flexible strips of wood nailed to stakes driven true to grade. The surface was given some degree of permanency by mixing cement with the sand.

[The above will be incorporated in a book soon to be published by Major Besson on the design of city streets —Editor.]

Costs of Installing Corrugated Pipe

Contractors and engineers are often confronted with the problem of deciding which of several types of culvert is to be constructed. Often the choice lies with that material which will give the lowest cost and the greatest serviceability. Data upon enough actual installations from which reliable costs can be ascertained will give to the contractor or engineer knowledge upon which a decision may be based. For that reason the article below has been prepared.—EDITOR.

IN A STUDY of several hundred thousand installations of corrugated iron culverts constructed in the state of California during the past ten years valuable figures have been made available for the cost of installing, both including and excluding the cost of pipe itself. The study covered installations in all sorts of terrain, from the most accessible flat valley to the most inaccessible broken sierras. Data were secured as well on all those diameters most widely employed—from 8 in. to 48 in. for costs including purchase price of pipe; and from 10 in. to 36 in., inclusive, for costs of installations only.

Fig. 1 shows the standard construction employed by the California Highway Commission. The design is the result of ten years' continuous use of corrugated pipe both under unpaved and hard-surfaced highways. Use of the pipe is about evenly divided between these two classes. About half a million feet of corrugated pipe have been laid along 2,500 miles of California highways, or an average of 200 lin.ft. to the mile.

Tables I and II show how the cost of installing corrugated pipe has varied from 1912 to 1921, a comparison which is graphically indicated in Fig. 2. Table I lists costs on jobs on which the contractor's bid included the purchase price of the pipe, Table II omitting that price.

The lowest installation costs were obtained in 1916, a fact which may be explained by the general low level of all costs and by the facility with which such installations were able to be made after four years of practice.

Contractors and engineers will perhaps be interested in comparing these unit costs with those obtained in

FROM JOB AND OFFICE

Hints That Cut Costs and Time

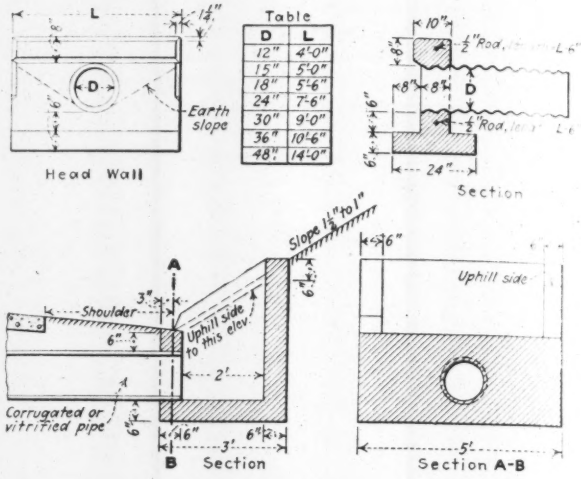


FIG. 1—STANDARD CULVERT INSTALLATION

TABLE I—COSTS PER FOOT OF INSTALLING CORRUGATED METAL PIPE
Cost of Installation including purchase price of pipe

Size	8-in.		9-in.		10-in.		12-in.		15-in.		18-in.		21-in.		24-in.		30-in.		36-in.		42-in.		48-in.	
Year	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Fee Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost
1912							6,716	1 68	508	1.65	1,792	1.84	26	4.70	1,062	2.38	419	3.24	139	3.77	6	5.00	225	6 00
1913					200	1.00	7,820	1 47			4,385	1.76			3,928	2.30	611	2.45	226	4.03			24	4 07
1914	320	2.42					30	2.66	13	1.34					468	1.78			79	2.90			22	5 23
1915					20	1.70													116	3.01				
1916	26	0.82	30	0.73			84	1 44																
1917	40	1.04					38	2 21			90	3.09	10	2.31	54	2.59	58	3.59	10	3.91				
1918							48	1 44			102	2.25												
1919															26	3.73			94	6.08				
1920																	80	4.78						
1921							1,916	2 89	148	3.00					450	4.60	34	7.00	44	7.90				
Total	386	2.16	30	0 73	220	1 07	16,652	1 72	669	1.95	6,369	1.81	36	4.04	5,988	2.45	1,202	3.06	708	4.20	6	5 00	271	5 77

TABLE II—COSTS PER FOOT OF INSTALLING CORRUGATED METAL PIPE
Not including purchase price of pipe

Size	10-in.		12-in.		15-in.		18-in.		21-in.		24-in.		30-in.		36-in.	
Year	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost	Feet Laid	Unit Cost
1912																
1913			1,896	0 65			342	0.85			110	1.00	106	1.15		
1914	70	0.50	56,315	0 64	3,391	0.66	41,051	0.76	224	0.68	21,996	0.89	4,124	1.10	1,723	1 02
1915			18,690	0 56	1,870	0 58	10,104	0.68	340	1.14	5,804	0.87	1,614	1.25	832	1 28
1916			2,349	0 40	614	0 44	1,866	0.55	40	0.60	1,224	0.82	138	0.92		
1917			25,246	0 67	1,622	0 82	16,287	0.89			10,360	1.01	1,288	1.12	759	1 02
1918			8,363	0 75	432	0 89	4,890	0.97			3,679	1.12	181	1.08	108	1 59
1919			20,486	0 98	5,196	1 11	12,273	1.13			9,230	1.57	744	1.96	493	2 36
1920			3,407	1 07			2,216	1.39			1,440	1.63	32	2.55		
1921			24,113	1 16	2,922	1.08	11,181	1.35			7,327	1.68	2,228	2.06	711	1 25
Total	70	0 50	160,865	0 77	16,047	0.89	100,210	0 91	604	0.94	61,170	1.14	10,455	1.38	4,626	1 26

FROM JOB AND OFFICE

For Contractor and Engineer

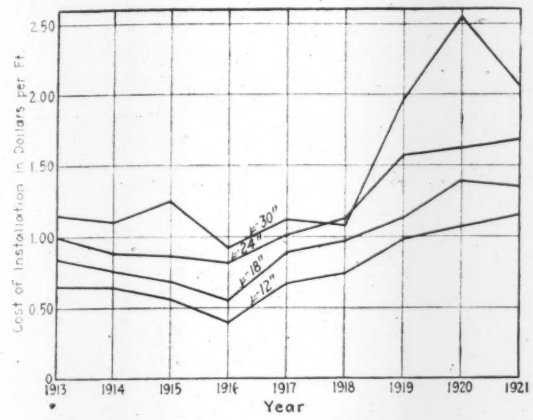


FIG. 2—UNIT PRICE FLUCTUATION ON FOUR PIPE SIZES

other representative states. The following figures have been compiled for Connecticut, Colorado and Oregon, in each of which states the highway commission employs large amounts of corrugated pipe. The costs include the purchase price of the pipe in each case.

UNIT COSTS FOR CORRUGATED METAL PIPE, INSTALLED

Connecticut[1]		*Colorado*[2]		*Oregon*[1]	
Size, In.	Cost, per Lin. Ft.	Size, In.	Cost, per Lin. Ft.	Size, In.	Cost, Per Lin. Ft.
14	$2.00	12	$2.257	12	$1.90
18	2.50	15	2.547	18	2.75
24	3.50	18	2.92	24	3.75
30	4.50	21	3.395	30	5.00
36	6.00	24	3.759	36	6.50
		30	4.715		
		36	5.802		

[1] Unit costs covering 1921 installations.
[2] Average unit costs covering first half of 1921.

Setting Slope Stakes

By A. O. Bosshard

Resident Engineer, Iowa State Highway Commission, Centerville, Iowa

I NOTICED the article in the issue of *Engineering News-Record*, Sept. 21, p. 490, by J. F. Webb, referring to an article by Paul McComb in your Aug. 24 issue, p. 303, regarding the use of a hand level, special rod and tape for setting slope stakes. I have developed a special rod, like Mr. Webb's, with a belt graduated from zero to 10 each way, on which I set off the center cut or fill. Then, any other point than center gives the cut or fill direct at that point, so that the only computations necessary are the slope distances, using an ordinary tape. With a specially marked tape, for 1½:1 slopes, which are standard here, this could be eliminated. In turning up or down, you merely have to take a shot at any convenient point, and reset the rod for that point. It is usually handier for the levelman to go out, and the rodman to hold the rod at center, and record.

In using this rod with a wye-level (which we usually do here as the Iowa commission prefers that we do not use the hand level), we set the centerline cut or fill at the height of instrument. For the rod moving out the zero would be above the eye height for a cut, and for the level moving, would be below. I have found this rod very handy, especially with rather inexperienced help.

Use of Motor Cars in Railway Work

IN A committee report recently submitted at the annual convention of the American Railway Bridge & Building Association, held in Cincinnati, considerable information was set forth concerning the use of motor cars in railway construction, particularly in bridge and building work. Many novel uses are being made of the motor car as a construction aid, the following extract from the committee report being typical.

The Chicago Great Western Ry. recently replaced the floor in a tunnel ½ mile long with concrete. Motor cars were used exclusively to haul the excavated earth and concrete. The cars used for hauling the excavation were side-dump cars of a capacity of 3 cu.yd. and the cars for handling concrete were bottom-dump cars holding 2 cu.yd. The mixer was set on a platform slightly elevated at the tunnel entrance. The concrete was run directly into the hopper car and hauled into the tunnel by a large air-cooled motor car. The arrangement worked out to the entire satisfaction of the management and effected a marked saving over other methods.

The Chicago Great Western also uses motor cars to pull weed cutters and to haul trailers carrying as many as forty men, or loaded with rails and material.

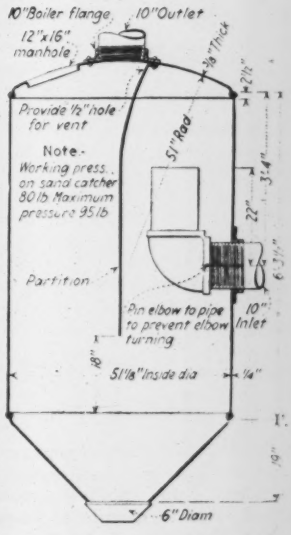
Sand Catcher Clears Cistern Water Pumped for Industrial Uses

By C. C. Brown

California & Hawaiian Sugar Refining Co., Crockett, Calif.

IN THE plant of a California industrial concern where use is made of large quantities of water, some trouble was experienced in the presence of sand in the lines. The amount of water pumped amounts to more than 3 m.g. per 24 hours. Water is taken from a cistern and from storage tanks and handled through two 1,300-g.p.m. centrifugal pumps with 200-ft. head. The water passes from the pumps through eight sand filters and thence through an 8-in. line to the house distribution pipes. Some time ago sand was noticed throughout the house. It did considerable damage to lines, bearings, meters and other apparatus. In order to remove the sand the sand catcher shown in the accompanying illustration was devised and installed in the 8-in. line just after it left the filters.

The sand catcher consists of a steel shell ¼ in. in thickness and of an internal diameter of 51¼ in. It is 6 ft. 3½ in. long with a curved top and a conical bottom. The water is led in through the side in an 8-in. pipe which terminates inside the drum in an 8-in. elbow and nipple. A baffle is installed as shown so that water cannot bypass to the outlet. The 8-in. outlet is at the top of the drum as is also a 12-in. x 16-in. manhole. A 6-in. drain valve is fitted into the conical bottom so that the trapped sand can be flushed away when necessary.



SAND CATCHER HANDLES 3 M.G. PER 24 HR.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Temperature Changes in Arch Dams

Sir—In the article by Fred A. Noetzli on "Arch Dam Temperature Changes and Deflection Measurements," given in *Engineering News-Record*, Nov. 30, 1922, p. 930, there appears formula (1), quoted from my paper on "The Circular Arch Under Normal Loads." This formula has been revised since publication, and the corrected formula will appear in the current issue of "Transactions," Am. Soc. C. E., p. 281. In brief form, it is,

$$D = c\,(ret_o),$$

where,

D = crown deflection in feet, positive when toward center,
r = radius of center line in feet,
e = coefficient of expansion = 0.0000055 (say),
t_o = change in arch temperature in Fahrenheit degrees, + for a rise, — for a fall of temperature.

The coefficient c is given numerically, for a hingeless arch, by Table 4, and, for an arch with "hinged ends," by Table 5, of the writer's paper quoted.

On solving the formula for t_o,

$$t_o = -\frac{D}{cre}$$

which should replace Eq. (1) of Mr. Noetzli's article.

On applying this formula to a few of the horizontal arches supposed cut from the Salmon Creek Dam, the data being taken from the table given on p. 931 of Mr. Noetzli's article cited, it is found that the numerical values of the temperature changes are somewhat less than those given in the table. Mr. Noetzli recognizes that the method proposed by him for ascertaining mean temperature change in any horizontal arch of a dam is only applicable in the case of cracked cantilevers, which offer no resistance to the expansion (or contraction) of the arch under a rise (or fall) of temperature, for the formulas refer only to a free arch.

When the dam remains intact, or the supposed cantilevers are not cracked, the method falls. The solution will then have to be for combined arch and cantilever action.

Chapel Hill, N. C., WILLIAM CAIN.
Dec. 2, 1922.

Sir—Since writing my article "Temperature Changes in Arch Dams," some temperature measurements made on a slender arch dam in Switzerland have come to me.

In the "Bulletin Technique de la Suisse Romande," Lausanne, 1922, (Étude sur les Barrages Arqués), A. Stucky describes the design and construction of a most remarkable arch dam on the river La Jogne in Switzerland. This structure is about 175 ft. high, and it was designed scientifically for combined cantilever and arch action, rib-shortening and temperature stresses.

During construction of the dam some 30 thermo-couples were placed in the masonry at various elevations of the structure, and after the chemical heat due to the setting of the cement had been lost or compensated for, the following annual range of temperature was observed:

Depth Below Crest, Ft.	Yearly Temperature Variation, Degrees Fahr.
3	43°
33	36°
66	22°
98	11°
164	4°

These figures which represent actual measurements, seem to confirm, to a certain extent, the reliability of the figures of Table I for the temperature variations in the Salmon Creek Dam as calculated from deflection measurements.

San Francisco, Calif., FRED A. NOETZLI.
Nov. 28, 1922.

Urges Constructive Criticism

Sir—In *Engineering News-Record* of Nov. 30, p. 947, appears a letter by George Rae of Portland, Ore., concerning the reinforcement of a highway swing span in Oregon. Mr. Rae proceeds to tell us wherein the other fellows erred, but does not state what he would have done if in their positions. That is not constructive.

Most of us are aware that the linear expansion of structural steel is about three times that of structural timber such as fir. Nevertheless many combination spans of steel and timber have been successfully built and used in the past. I know of several such spans where the top chord is of timber and the bottom chord of steel, and these have served for a good many years. It is true that the combination is not exactly an ideal one.

The complete details of the alleged "doubtful bridge reinforcement" are not at hand. It appears that if the rivets in the bottom chord were backed out, in order to insert the bolts for attaching the thrust blocks, there would be no weakening of chord in tension; whether new holes were drilled is not stated. The timber reinforcement of the bottom chord doubtless has been effective in preventing further buckling of the chord, and should stiffen up the members even if the thrust blocks were removed. The two 14 x 14-in. timbers at least serve to reduce the slenderness ratio of component parts of chord when in compression, with span swinging free.

Permanent reinforcement of structural steel would probably have required several months for delivery and erection. In an emergency, such as I judge this was, something effective had to be done even if only of a temporary nature. Presumably, the two county officials, and not Mr. Rae, were bearing the responsibility; and they no doubt used their best judgment in the matter.

The added dead-load due to the asphalt paving caused a shortening of the bottom chord as well as the lengthening of the top chord; and the latter was probably aggravated by heat from the sun's rays. In the writer's experience this same sort of thing has happened in timber Howe truss draw spans. Turnbuckle adjustment of hog-bars and shimming or a runoff at the ends are a practicable means of solution; also, additional hog-bars over a gallows-frame at center of span might well be placed.

The last sentence in Mr. Rae's letter is a decidedly inconsistent conclusion. If the aforesaid county officials are incompetent the registration board should refuse to renew their certificates. Otherwise, it seems that unfair criticism of other men's work should be stopped. I am interested in the ethics, as well as the engineering, involved in this case, else I would not have taken the pains of replying to Mr. Rae's letter.

H. A. GERST,
Registered Professional Engineer.
Asst. Bridge Engr., Great Northern Ry.

St. Paul, Dec. 2.

Painting Galvanized Sheets; Why Galvanize?

Sir—Referring to the letter of F. H. Thomson, on "Painting Galvanized Sheets," in your issue of Nov. 2, p. 759: It has often been a wonder to us why it was necessary to galvanize iron sheets when used for roofing purposes, as it becomes necessary to paint these sheets in a comparatively short time after being exposed to the weather, and unless a special paint is used (such as manufactured by us under the name of No. 625 Galvanized Iron Primer) or unless a special wash is applied before ordinary paint is used, the paint is very apt to peel off. Under the circumstances, it seems an unnecessary expense to galvanize under the present commercial practice, as the painting of the black metal will give just as good results as painting over the galvanized iron surface. The only advantage that we can see is in the transportation of the metal sheets, which, of course, would become rusted when not galvanized unless protected from the weather; but this same protection would be obtained at a lower cost by the application of a shop coat of paint in place of galvanizing.

However, if it continues to be the practice to galvanize in a commercial way, and therefore it becomes necessary to

paint, first-class results can be obtained by using a special galvanized iron primer instead of incurring the extra labor of neutralizing the galvanized iron surface before the application of an ordinary paint, and we will be very glad to furnish further information to any interested party. We do not favor allowing the galvanized surface to weather for a period of six to nine months, or until corrosion starts, as the usual tendency is to allow this weathering to proceed too long, and corrosion has started too vigorously before the application of paint. As it is usually necessary to paint in six to nine months, the material had better be painted when erected and thoroughly protected at that time.

CHEESMAN-ELLIOT CO., INC.,
F. P. CHEESMAN,
President.

Brooklyn, Dec. 5.

Data Used for Storm Sewer Design at Milwaukee, Wis.

Sir—Referring to that portion of J. R. Hendry's article in *Engineering News-Record*, Nov. 2, p. 745, which relates to the basic data adopted for the design of Detroit's storm-water drainage system, the writer takes this opportunity to show the marked degree of similarity existing between these data and those used for similar purposes in Milwaukee and its vicinity.

The accompanying curve (Fig. 1), which is based upon the United States Weather Bureau records, 1905 to 1921, covers a period of seventeen years and was prepared by the writer during May of the present year primarily for use in connection with the investigation and development of drainage areas in the Metropolitan territory in close proximity to the city of Milwaukee, and also for general use in connection with storm-sewer development within the city. The various points on the curve will be seen to conform quite closely to those derived from the use of Mr. Hendry's mathematical expression showing the assumed relation between duration and intensity $i = 136/(t+20)$. See dotted line, Fig. 1.

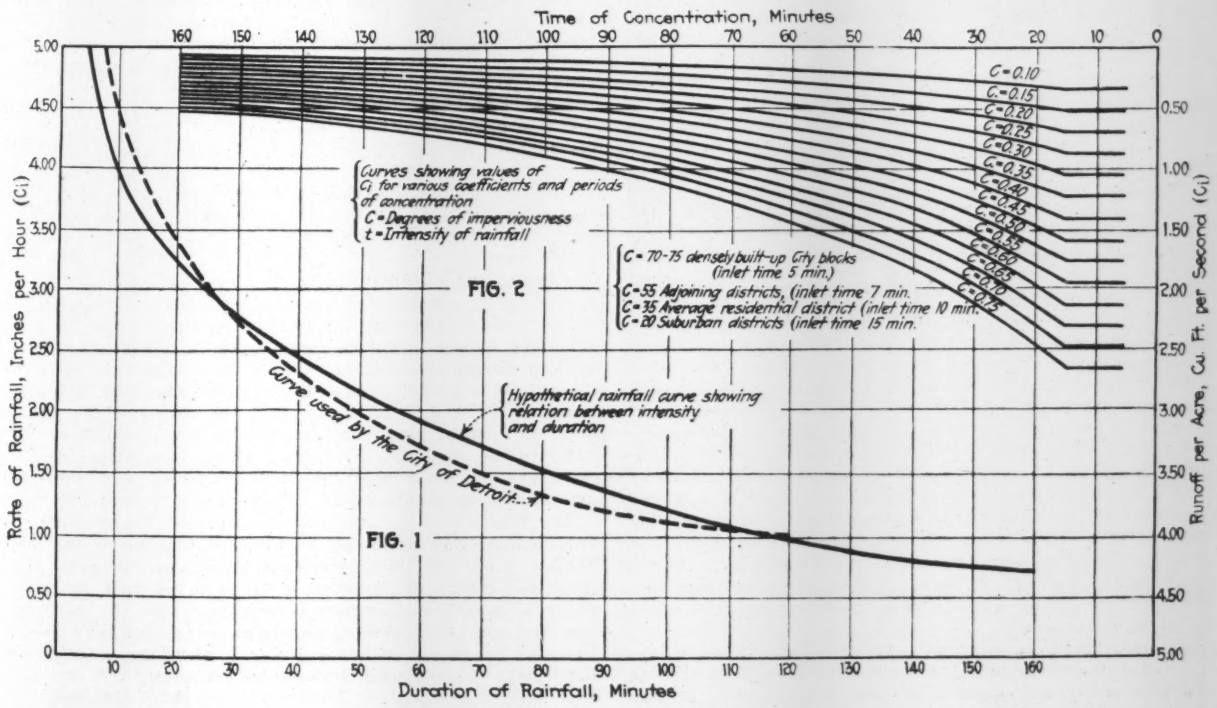
While in reality there is no apparent reason why any mathematical law should govern the relation between duration and intensity, and for this reason no formula was prepared by the writer, the formula affords a convenient method for computing intensities when the curve itself is not available.

For all practical purposes Mr. Hendry's formula will produce results sufficiently close to suggest its use in lieu of the Milwaukee rainfall curve. Studies of present day tendencies toward home building in the residential portions of Milwaukee appear to indicate that a runoff coefficient of 0.35 is well on the side of safety. Accordingly it has been adopted for use in connection with storm-sewer design for the average residential district. It should be noted that this factor, too, is in close agreement with the figure used by Mr. Hendry.

It has been found convenient to construct a secondary set of curves (Fig. 2) which show rates of runoff corresponding to rates of rainfall for various runoff coefficients. These curves give direct readings in second-feet per acre for the time of concentration and the coefficient of runoff under consideration. In referring to the secondary curves it will be noted that a flat rate of runoff is assumed to obtain during the maximum allowable period of concentration at the most remote inlet, and also that the time of concentration at the inlet is assumed to decrease as the value of the runoff coefficient is increased. The reason for the use of this method is, that the use of high rates of rainfall corresponding to the short periods of duration results in sewer sizes at the beginning or upstream end of a system, which, in the light of past experience, appear to be considerably larger than are actually required. It is at the beginning of a system, as the writer views the situation, where a reduction in the indicated quantity is possibly more reasonably warranted than at some point or points farther down the line. This statement is not made, however, in criticism of Mr. Hendry's method of effecting reduction in quantity by applying the indicated runoff for a fifty-minute concentration period to the accumulated area above the point in consideration. On the contrary the writer is inclined to believe that this method is logically permissible, especially in view of the fact that storms of maximum intensity for short duration periods are localized and confined to limited areas.

DARWIN W. TOWNSEND,
Engineer of Designs, Milwaukee Sewerage Commission.

Milwaukee, Wis., Dec. 7.


Time of Concentration, Minutes
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
Rate of Rainfall, Inches per Hour (Ci)
5.00 4.50 4.00 3.50 3.00 2.50 2.00 1.50 1.00 0.50 0
Runoff per Acre, Cu. Ft. per Second (Ci)
0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
C=0.10
C=0.15
C=0.20
C=0.25
C=0.30
C=0.35
C=0.40
C=0.45
C=0.50
C=0.55
C=0.60
C=0.65
C=0.70
C=0.75
Curves showing values of Ci for various coefficients and periods of concentration
C=Degrees of imperviousness
t=Intensity of rainfall
FIG. 2
C=70-75 densely built-up City blocks (inlet time 5 min.)
C=55 Adjoining districts, (inlet time 7 min.
C=35 Average residential district (inlet time 10 min.
C=20 Suburban districts (inlet time 15 min.
Hypothetical rainfall curve showing relation between intensity and duration
Curve used by the City of Detroit...
FIG. 1
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Duration of Rainfall, Minutes

CURVES FOR DESIGN OF STORM SEWERS

Based on rainfall data for Milwaukee and vicinity obtained from the records of the United States Weather Bureau, 1905 to 1921.

Ventilation, Body Temperature and Health

Sir—We should all heartily agree with most of the statements made in the letter by F. W. Harris in your issue of Dec. 7, p. 989, headed "Sanitation, Ventilation, and Vaccination." Regarding the subject of ventilation, it seems that we, including some of those who ought to guide us in health matters, hardly yet fully understand or at least appreciate all the facts relating to it. Mr. Harris very properly says that the object of ventilation is to supply fresh air and to maintain the proper temperature. There is a surprising ignorance among people at large regarding fresh air and ventilating, particularly as to proper temperature. I believe that we more often suffer illness, including colds, and sometimes even deaths, starting from a temperature cause than from any other single source.

Fresh air is air that has a definite mixture of nitrogen (76), oxygen (23), carbon dioxide (0.0005), and small amounts of argon, ozone, ammonia, organic and mineral matter. We know how far a deviation from the relative quantities is permissible, to cause first discomfort, then illness, and finally death. Our momentary judgment regarding comfort and healthfulness is guided by our senses, chiefly by odors, temperature, and slightly by humidity. We cannot accurately measure these sensations, except by thermometers and hydrometers, but our nostrils and our skin are generally sufficient informers.

I cannot forget the impression made upon me when a boy on entering a small shoemaker shop to have my shoes repaired. It was winter and cold outside. A family of about six lived in a small room. I was fairly stunned, as the air was thick, and its odor intensely disagreeable. "Why don't you open the window and get some fresh air?" "Why that would make us all sick by letting out the heat, and coal is too expensive." "But you will all get sick in this air." "None of us has ever been sick for years," the chorus replied. For the first time in my life did I realize that proper temperature might be of more importance than the popular idea of fresh air.

Since then I have made a number of observations along these lines and found that our general education along them might be much improved. We often have our rooms too hot or we expose ourselves to a cold temperature, with our skin and clothes improperly conditioned.

A few years ago, when wintry weather was setting in, our papers reported much bronchitis, influenza, and pneumonia, and most people one met had colds. Posters were put up in the street cars and elsewhere, urging people to open their windows wide at night to keep off those diseases. Unfortunately it was a cold winter and the death rate from such cases, usually starting with a cold, ran very high.

There can be no doubt that the air, particularly, in our large cities, can be kept as pure as we can get it. But it is of still greater importance to our personal comfort and health to have the temperature conditions next our bodies such that they keep us in good health. The chief reasons for this greater importance are the frequent and great changes of air temperature (daily, seasonal, indoors and outdoors), to which the body must continually adjust itself.

Blood temperature is about 99 deg. F., or a trifle less. A few degrees above will cause fever and a few more death; a few degrees below 99 will cause a chill and a few more death. It is therefore highly important that we maintain our normal blood temperature as nearly as practicable, because inside of our bodies a variation of comparatively few degrees from the normal may be fatal.

In cold climates nature provides animals with furs and men wear suitable clothing to produce a non-heat-conducting covering around the body, thus preventing an excessive loss of heat, as engineers do by covering steam pipes. On the other hand physical exercise and rubbing of the skin mechanically produces heat within the body, and thus raises the blood temperature.

We have therefore acquired some knowledge of the means to protect ourselves under existing conditions from sinning against the infallible natural laws of temperature. But we could go much further in this acquisition and prevent many cases of sickness and death produced by temperature causes alone, if our instructors would spread more information among us, first, about the importance of maintaining our bodies always at the proper blood temperature, and secondly, by pointing out in detail the ways in which we could best do this at home and out of doors and both in summer and in winter.

In other words, we should consider our body to be a "heat engine," and treat it as rationally as we do a steam-engine and realize that prevention of mishaps is better than their cure.

New York City,
Dec. 10.

RUDOLPH HERING,
Consulting Engineer.

Mechanical Amusement Devices Are Safe

Sir—In a recent issue of your magazine appeared an article criticizing the mechanical amusement devices as operated in parks and fairs and advocating the complete abolition of these devices. It is apparent that the writer of your article was misinformed. It is not true that this business originated with the Chicago world's fair. There were scores of patents on such devices fifty years ago. There were merry-go-rounds in France more than a century ago. There have been mechanical Rides at Coney Island for fifty years. Several manufacturers in America alone have been building these devices for thirty to forty years.

From the accident standpoint these Rides are safer than any other means of human locomotion. Several manufacturers report having built hundreds of Rides in forty years which have carried from thirty to one hundred million passengers without serious accidents. There is hardly a railroad or street car line that can show such a record. The automobiles of America are killing more than one hundred people per week, whereas all the amusement devices of the country have not killed one hundred patrons in the past fifty years.

Most of these Rides are designed by engineers and mechanics having a lifetime of experience. They have devoted years to the question of safety. Scores of safety devices have been designed and patented. In the larger cities a special division of the building department approves the plans before a new Ride is erected. An annual inspection is given before the license to operate is renewed. From these inspections the number of accidents has been reduced to almost nothing. They are so safe that a number of the biggest insurance companies are insuring these Rides against public accident liability for a very low annual cost. Many operators consider the risk so slight that they carry their own accident risk.

These devices are not "cheaply built." Small Rides cost from $4,000 up to $25,000. The big Rides cost up to $50,000 and many over $100,000. Probably $100,000,000 is now invested in Rides in America. The receipts are estimated by amusement men at $50,000,000 per year, of which over five million has been paid annually in recent years in taxes to Uncle Sam.

These Rides are located in parks most of which are managed by amusement men of long experience. They know that it is a vital point for them to maintain order, a high standard of conduct and clean moral conditions in these parks. Surely nothing is cleaner or more highly moral than a ride in a merry-go-round, a ferris wheel or a roller coaster. Park men all agree that the Rides are the most popular form of park amusement. They attract the people out into the open, the air rings with peals of laughter and the cost is so small that the working classes and even the poor are large patrons.

The National Association of Amusement Parks holds an annual three day convention in Chicago, together with a big exhibition of new Rides and improvements on old ones. The inventive genius of America is taxed to produce new mechanical novelties. America is now the center of the industry, and scores of new Rides are exported annually to all parts of the world to bring smiles to the faces and joy to the hearts of the young folks across the seas.

H. G. TRAVER,
Pres., Traver Engineering Co.

Beaver Falls, Pa., Dec. 5.

NEWS OF THE WEEK

New York, December 14, 1922

Fire Does $15,000,000 Damage to Astoria, Ore.

Engineering Interests Attaches to Conflagration as City Was Built on Piling

Special Correspondence

Particular engineering interest is attached to the fire which destroyed the business section of Astoria, Ore., Oct. 8, doing property damage estimated at $15,000,000, because of the fact that the greater portion of the business district was built on piling and only partially protected by an hydraulic fill. As every hotel, bank, theater, restaurant wholesale and retail house in the business district was destroyed, the control of the city has been put in the hands of a committee of business men whose announced policy is to confine temporary buildings to an unoccupied district and to rebuild the burned area with wide streets filled to grade.

The greater part of the business district of Astoria was built originally on piling over tide flats. Construction was mostly of wood with a few good buildings of modern type. In 1916 the city built a sea wall of heavy sheetpiling and raised the grades sufficiently to allow for basements, and made an hydraulic fill to the basement level.

Concrete Construction Urged

Owners raised their frame buildings on temporary wooden walls. Engineers at that time urged the construction of retaining walls along the curb lines with reinforced-concrete floors carrying the pavement and providing subway space for sewers and water mains. This plan was adopted and bids were taken, but before any contract was let heavy corporate and private property interests secured an injunction against construction on the ground that the cost would practically confiscate the property improved. The city council thereupon adopted the plan of viaducts of creosoted timber with plank floors carrying bitulithic pavement and with 4-in. hollow tile bulkheads secured to the timber frame along the curb line. This bulkhead along the curb line was continuous around each block but did not cross streets. The cost was $10 per front foot less than concrete.

The city fire chief had constantly urged property owners to build tile or concrete basement walls to reduce the fire hazard, but the extent to which this was actually done cannot now be ascertained. The entire district was thus supported several feet from the ground with continuous air space for draft.

The fire broke out about two o'clock in the morning. Appearance of it in several places at once caused suspicion of incendiarism but that fact was probably due to the city's construction. Steamers moored along the waterfront saved the docks with the aid of a strong on-shore wind, but in the balance of the filled district, the fire was beyond control almost from the beginning. At one time it was thought to be entirely stopped but suddenly appeared two blocks farther on. When the fire reached the edge of the filled district it was quickly checked. The burned and filled areas approximately coincided. Some hours after the fire started the water supply became inadequate. The details of the failure are lacking but it was possibly due to the excessive demand made upon hydrants, or the fact that they were broken by the falling viaducts. Newspapers report that the water mains were carried on viaducts but this is incorrect.

Buildings were dynamited but the attempts made to destroy the viaducts failed as the open character of the construction made it impossible to apply powder effectively. The pavement prevented reaching the fire, and caused the structures to act as flues.

Concrete Resists Fire

Examination of the burned-over area has been made by R. A. McLanathan, city engineer of Astoria, and part of his findings have been communicated to *Engineering News-Record*. His telegram follows:

"A large majority of the buildings within the burned area were frame and nearly all on piles or posts with many of the basements not enclosed. Nearly all of the streets in this area were of timber viaducts, with concrete walks and bitulithic streets laid on timber decking. Under the viaducts and along

(Continued on p. 1044)

Highway Officials Hold Annual Convention

Kansas City Meeting Largest in the History of the Association —Committee Reports of High Technical Character

Engineering News-Record Staff Correspondence

HIGHWAY administration, overshadowing questions of design and research, stood out as the subject of general interest, at the convention held last week at Kansas City by the American Association of State Highway Officials. Beginning with the address on highway department organization (p. 1028 of this issue) by A. R. Hirst, state highway engineer of Wisconsin, administration continued to be the thought uppermost in the papers and discussions on federal aid, construction and maintenance. Committee work was the second outstanding feature of the convention. One half-day period was devoted solely to committee meetings and reports were presented by all the standing committees and especially significant reports by the committees on tests, on construction, and on contractural relations. Those reports expressed the more strictly technical activities of the convention.

As the amendment to the constitution, which increased the state dues to $200, was carried, money is expected to be available for the publication of these reports. Indeed the report of the treasurer, Frank T. Sheets, superintendent of highways of Illinois, showed the finances of the association to be in an unusually good condition. With all bills paid there are $4,044.41 in the treasury. At the election of officers Mr. Sheets was re-elected treasurer and Charles M. Upham, state highway engineer of North Carolina, was re-elected secretary. The new officers elected were C. J. Bennett, state highway commissioner of Connecticut, president, and Fred R. White, state highway engineer of Iowa, vice-president. The new members of the executive committee are G. P. Coleman (re-elected) state highway commissioner of Virginia; Z. E. Sevison, state highway engineer of Wyoming; C. M. Babcock, commissioner of highways of Minnesota, and Frank F. Rogers, state highway commissioner of Michigan. The resignation was announced of G. E. Johnson, secretary, department of public works of Nebraska, who is leaving office. The deaths were announced of John N. Cole, commissioner of public works of Massachusetts, of Fred W. Sarr, deputy commissioner of highways of New York and of William D. Uhler, chief highway engineer of Pennsylvania.

Finance and Design

The discussions on finance and design were largely reviews of subjects—such as the Bates and the Pittsburg road tests and the financial plans of the California highway commission—which have received rather complete publicity during the last twelve months. In discussing finance Austin B. Fletcher, late state highway engineer of California, covered the ground of a portion of his annual report the conclusions of which are published in another page of this issue.

The articles on the Pittsburg road tests in *Engineering News-Record* June 29, 1922, pp. 1066 and 1069 and Nov. 23, 1922, p. 893, contain much of the matter presented in a paper by T. E. Stanton, assistant state highway engineer of California. In general, Mr. Stanton stated, the tests indicated the strongest pavement to be one with edges thicker than the center depth as, for example, a 9-6-9 in. section for heavy traffic and a 7-5-9 in. section for lighter traffic. In this respect of cross-section, Clifford Older, in reviewing the Bates road tests, announced substantially the same conclusion. Bridge design was discussed by Llewellyn N. Edwards, bridge engineer of the state highway commission of Maine. Emphasis was placed on location, waterway and design to insure good construction.

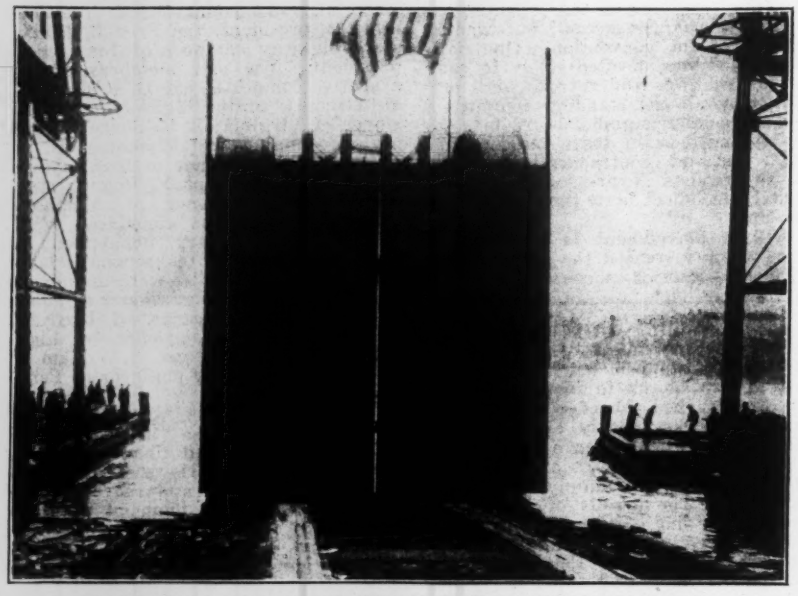
(Continued on p. 1044)

Launch Caisson for N. Y. Vehicle Tunnel Shaft

Driving of South Tube Halted by Blow Resulting from Nearby Excavation—Present Status of Project Reviewed

DURING the last couple of weeks two interesting developments have taken place in connection with the driving of the 30-ft. vehicle tunnels under the Hudson River to connect New York and Jersey City. One of these is the temporary suspension of driving on the south tube and the other is the launching of the first section for the caisson that is to form the New York river shaft. What follows is a condensed survey of the present status of the project from its construction aspect.

The principal elements of the tunnel project are the two tubes, the two land shafts at each end from which the tubes are driven, and the river shafts, a double shaft at the New York end and two single shafts at the New Jersey end. These river shafts are close to the pierhead lines and will serve to assist in the ventilation of the tunnels.



NEW YORK VEHICLE TUNNEL CAISSON LEAVING THE WAYS

This caisson will form the lower 35 feet of the New York river shaft for both tubes. Projecting above the side plating may be seen the circular sections by which the shields will pass through the shaft.

Six shields will be used. Two are to drive under the river from the New York land shaft while two from the New Jersey land shaft are driven to meet them. The other two will drive westward from the New Jersey land shafts. The tunnels from the New York land shafts eastward will not be driven by shield.

The two land shafts at the New York end have been completed. The south shaft was put under air during the last week in October and about Nov. 4 driving was begun. By the end of November, the shield had progressed about 68 ft. when it was halted because of the blowing of some 150 yards of earth, brought about by the proximity of the tunnel face to an adjacent excavation in which a city sewage plant is being built. Driving was stopped and the shield now rests with its top about 25 ft. below the surface of the ground and its cutting edge about 40-ft. from the nearest point of the excavation.

This excavation is rectangular in plan, about 45 x 90 ft., with its longitudinal axis between 40 and 45 deg. to that of the tube. It lies to the south side of the tunnel line with its nearest corner only 7 ft. distant from the outside line of the tube. The elevation of the bottom of the excavation is about 10 ft. below the top of the tube at the point nearest to it, this decreasing because of the falling grade of the tube to about 6 ft. at the far end.

The sides of the excavation are retained by steel sheet-piling which has been driven around the site about 2 ft. outside the neat line of the concrete walls and to a depth that brings its bottom edge just above the elevation of the center line of the tube. Foundation piles have been driven and a layer of concrete deposited by tremie. It will be seen that the open space between the outside of the walls and the sheetpiling would remain during the erection of the building, at least until it had reached the level of the surface, and as the contractor had estimated on no concrete for this space and on salvaging his piling he was unwilling to seal up this opening.

An attempt to drive the shield past this obvious outlet for the compressed air would have been futile and hazardous, and the losses to all concerned that would have been entailed by so long a delay would have been so great, that the tunnel commission has negotiated a contract whereby the space is to be filled with concrete and the sheetpiling left in place at the expense of the tunnel project. The contract for this work amounts to approximately $16,000 which is bare cost and includes no profit. It is expected that this work will have been sufficiently completed to enable a resumption of tunnel driving during the coming week.

The shield that will drive the New York end of the north river tunnel is now almost completely assembled in the shaft, and it probably will be ready to start driving soon after the first of the year.

The steel caisson launched on Dec. 5, at the Staten Island Shipbuilding yard at Mariner's Harbor, Staten Island, consists of the lower 35 feet of the New York river shaft. It is designed to include the two tunnels and is 35 x 91 ft. in plan. An addition of 20 ft. in height is now being erected, after which the caisson will be towed to its site at the New York pierhead line and sunk by depositing concrete between its inner and outer shells. The sinking probably will be begun soon after Jan. 1.

The total height of the finished caisson will be about 108 ft. It will rest on ledge rock which at that point rises above the tops of the tubes. Circular bulkheads have been provided in the east and west walls of the caisson. When the shields reach them these bulkheads will be burned out, thereby permitting the shields to continue their passage through the caisson and out on the far side.

The two New Jersey shafts, which are not in one unit, will rest with their bottoms about 150 ft. above rock, and in order to insure their stability in the Hudson River silt, reinforced-concrete piles of special design are to be sunk to rock. Those for the north caisson are now being installed. This caisson probably will be launched in about a month. The south caisson also is under construction but will not be placed until spring.

At the New Jersey end the north land shaft is about half sunk and the caisson for the south land shaft is about two-thirds assembled. It is expected that one shield for the New Jersey end will be delivered shortly after Jan. 1.

Voters Defeat California Law Against Shingles and Lath

A referendum vote in California at the November election defeated by a large majority a law passed by the 1921 legislature which prohibited the use of wood lath and shingles on the exterior walls and roofs of new buildings in incorporated cities. As the law was phrased, its prohibitory effect in the direction referred to was not at first apparent, and when it was discovered a referendum vote on the act was petitioned for.

State Ownership of Water Power Defeated in South Dakota

A project for state development and operation of a hydro-electric plant on the Missouri River near Mobridge, S. Dak., was defeated by a large majority in the November election in South Dakota. The project included the construction of transmission lines to serve cities and towns in the eastern part of the state. The proposed bond issue was for $16,000,000 and according to estimates of the state's engineers it would be several years before the system could approach a self-supporting basis.

Am. Soc. C. E. Announces Plans for 70th Annual Meeting

The seventieth annual meeting of the American Society of Civil Engineers will be held Jan. 17, 18 and 19, 1923, at the offices of the society, Engineering Societies Building, 33 West 39th St., New York.

The opening session on Wednesday morning, Jan. 17, will be devoted to the transaction of business, reports of committees, conferring of honorary membership, award of medals and prizes, and the announcement of the result of the ballot for officers. At the afternoon session the subject of engineering education will be considered. This will be a joint session with the Society for the Promotion of Engineering Education. On Wednesday evening the president's and honorary members' reception will be held, which will be followed by a dinner-dance.

For Thursday, Jan. 18, an all-day excursion to Bethlehem, Pa., has been planned. Visits will be made to the Bethlehem Steel Co., Lehigh University, and the Hill to Hill Bridge now under construction. Thursday evening, the annual smoker will take place at the society headquarters.

The subject for the morning session on Friday, Jan. 19, will be engineering research, and for the afternoon session, city planning.

A new feature this year will be the meetings of the new technical divisions. On Tuesday evening, Jan. 16, the technical division on sanitary engineering will hold a dinner-meeting at 6 p.m. at the Hotel McAlpin. Other technical divisions will meet Friday evening, Jan. 19.

The committee on local arrangements is as follows: Charles Gilman, chairman; W. G. Grove, B. B. Hodgman, C. M. Holland, T. R. Kendall, George Lucas, Thaddeus Merriman, J. F. Sanborn. The general program is in charge of the standing committee on technical activities and publications, John R. Freeman, chairman, C. E. Grunsky, Clarence W. Hudson, Richard L. Humphrey, J. J. Yates.

Oklahoma Society Joins American Association of Engineers

Amalgamation with the American Association of Engineers was voted upon favorably by the Oklahoma Society of Engineers at its annual meeting Dec. 2 in Oklahoma City. The state society with the chapters at Muskogee, Tulsa and Oklahoma City will form the Oklahoma Division of A. A. E. A program of state activity outlined includes a license law for engineers, amendments to the paving law and a good-roads program, all of which meet with the favor of J. C. Walton, governor-elect and a member of the organization. Officers elected to head the new division are as follows: President, Dan W. Patton; vice-president, Max L. Cunningham and secretary-treasurer, E. K. Ramsey, Oklahoma City.

City Manager Plan Adopted at Stockton, Calif.

At a city election at Stockton, Calif., on Nov. 28, an ordinance providing for a city manager form of government was carried by a majority of about 3 to 1.

Bethlehem Gets Philadelphia Tower Contract

On December 1 the contract for the steel towers for the Philadelphia-Camden suspension bridge over the Delaware River was awarded to the Bethlehem Steel Co. by the Delaware River Bridge Joint Commission (of Pennsylvania and New Jersey). Their bid, as reported in our last issue, page 1,000, was for $1,386,974. The next lowest bidder was the Keystone State Construction Co. and the New York Shipbuilding Corp. jointly, for a price of $82,330 higher.

The contract is required to be completed within 15 months.

St. Louis Will Vote on Bond Issues Totaling $88,372,500

The Board of Aldermen of St. Louis, Mo., on Nov. 17 passed an ordinance authorizing a bond issue election to be held Feb. 9, 1923. Twenty-one propositions, involving a total outlay of $88,372,500, will be voted on separately. A list of the several propositions follows:

1.	Establishing, opening and widening streets	$8,650,000
2.	Acquisition of land for a plaza opposite union station	2,600,000
3.	Improvement of streets and highways	5,800,000
4.	Electric street lighting system	8,000,000
5.	New court house	4,000,000
6.	Construction and reconstruction of public sewers	8,000,000
7.	Conversion of river des Peres to a public sewer	11,000,000
8.	Acquisition of land for new parks and playgrounds	2,500,000
9.	Improvement of existing parks and playgrounds	1,300,000
10.	Aquarium in zoological Park	400,000
11.	Municipal light, heat and power plant	1,000,000
12.	Hospital extension and improvement	5,000,000
13.	Municipal auditorium	5,000,000
14.	Memorial plaza	6,000,000
15.	Fire department improvement	772,500
16.	Elimination of railroad grade crossings	1,600,000
17.	West approach to municipal bridge	1,500,000
18.	East approach to municipal bridge	1,500,000
19.	New armory	1,000,000
20.	Reconstruction of public markets	1,250,000
21.	Water-works extension	12,000,000
	Total	$88,372,500

Higher Water Rates in Hoboken for Hackensack Water Co.

The New Jersey State Supreme Court has referred back to the Public Utility Commission of that state for revision upwards a rate decision estimated to produce $913,785 of revenue in Hoboken for the Hackensack Water Co. The court declares that a fair return would be between $925,000 to $950,000, until such time as a deficit is eliminated.

American Water Works Convention Date and Place Fixed

The date and place of the 1923 convention of the American Water Works Association has been announced as May 21 to 25, at the Hotel Statler, Detroit, Mich. Those having program suggestions to make are requested to send them to Abel Wolman, editor, 16 West Saratoga St., Baltimore, Md.

Road Builders Prepare Comprehensive Program

Design, Construction, Maintenance Traffic and Finance to be Given Special Treatment

A comprehensive program which embraces not only the salient problems confronting road engineers, executives, and others interested in highway construction but which will go into detail in the discussions has been prepared by the American Road Builders' Association for the annual convention to be held in Chicago, Jan. 16-19, inclusive. In connection with the Road Builders' Association will be held the thirteenth American Good Roads Congress, an exposition which promises to eclipse all previous things of the sort.

The road builders' program itself has been divided into five main parts, which will deal with thorough discussions of design, construction, maintenance, traffic studies and finance and miscellaneous considerations. Aside from this will be a general session which will precede the specialized sessions and at which main problems confronting the industry will be outlined by men of prominence.

At the session on design, which will be presided over by Thomas H. MacDonald, chief of the Bureau of Public Roads, intimate discussions will be given of design features which have been revealed as a result of traffic runs made on the Bates test road in Illinois, the Pittsburg test road in California, and the Arlington road maintained by the Bureau of Public Roads, Washington. The construction session will be presided over by J. H. Cranford, president of the Cranford Paving Co. of Washington, D. C., and during the session all the ways in which materials are handled in the construction of concrete roads will be thoroughly gone into. In addition, winter construction and lost time will be discussed.

The maintenance session will be presided over by A. R. Hirst, Wisconsin State Highway Engineer. Organization for maintenance work, patrol maintenance, gravel road maintenance, blade-grader and road-drag earth road maintenance, salvaging and maintaining macadam roads will be special subjects discussed. Thomas J. Wasser, state highway engineer of New Jersey and president of the American Road Builders' Association, will preside over the traffic session on the afternoon of Jan. 18. The effect of traffic on construction and what changes may be needed in motor vehicle legislation as results of studies will be special topics discussed. Frank Page, highway commissioner of North Carolina, will preside over the session which will discuss finance.

At the same time the thirteenth Good Roads Congress and the American Road Builders Association meetings are going on, the National Crushed Stone Association and the Midwestern Section of the American Association of Engineers, and several other organizations will hold conventions in Chicago.

As noted on p. 1048, manufacturers and the publisher of "Engineering News-Record" have co-operated in telling the story of the forthcoming meeting in a 23-page announcement appearing in the advertising pages of this issue.

Highway Officials Hold Annual Convention

(*Concluded from p. 1041*)

Calling attention to the public protest, as evidenced by the recent elections, against present economic conditions and its possible reactionary effect on highway expenditures, Thomas H. MacDonald, chief, Bureau of Public Roads, called on the states to centralize their highway administration particularly with a view to the state control of money for construction. With county initiation of construction and county control of the money difficulties were introduced into the direction of federal aid which retarded road development.

In discussing the management of Federal Aid, Rollen F. Windrow, consulting engineer, Missouri State Highway Department, criticised the delay experienced in getting approval of projects and securing federal-aid payments. He considered that the direction of federal aid should be decentralized by putting a federal engineer in every state with authority to give decisions and that at least in each district there should be a disbursing officer to expedite payments which had been earned. To reduce delays in the procedure by the state he considered that increased centralization of all federal business in the state highway department was necessary.

Continuing this subject Frank T. Sheets, superintendent of highways of Illinois, pointed out that delay had generally been due to non-conformance of the state with known requirements of the federal bureau. If the state presented its project properly its approval was reasonably prompt. A. R. Hirst, state highway engineer of Wisconsin, stated that as director of state aid to counties he had been subjected to every sort of criticism from the counties that the federal bureau was now receiving from state highway departments and the reason was much the same: "both were trying to put something over."

Maintenance administration was discussed in papers by G. G. Dillman, deputy commissioner, Michigan State Highway Department, and H. K. Bishop, chief of construction, Bureau of Public Roads. Mr. Dillman described and upheld the practice by which maintenance is performed through county road departments with the state highway department in control. State maintenance directly was described and advocated by Mr. Bishop. Active discussion followed with J. T. Donaghey of Wisconsin and F. F. Rogers of Michigan upholding administration through county departments and A. H. Hinkle of Indiana, W. R. Neil of Georgia and others advocating maintenance directly by the state. A simpler organization and closer control were the advantages claimed for state maintenance. In support of the practice of maintenance through the counties it was urged that education of the people in good road-building and maintenance by giving every locality a hand in the work was a distinct aid in highway development.

Four of the standing committees—standards, administration, maintenance and motor truck regulation—announced progress. Substantially finished reports were presented by the committees on construction, tests and co-operation with contractors.

The committee on bridges announced the completion of specifications for steel bridges and corrugated culverts and stated that further specifications were far enough advanced to make possible the promise of their completion in 1923. Forms for advertising, bidding forms, forms of contract, were recommended by the committee on specifications. These are substantially the same forms as are employed by the North Carolina Highway Commission.

In general, the committee on standards recommended that, while design standards must wait on the conclusion of research work now in hand, pavement slabs should have edges at least as thick as the center; subgrade should be loosened at least 8 in. deep and recompacted by rolling; concrete thickness should be reduced no more than one-fourth for base surfaced with other material, and surface variations as shown by a 10-ft. straight-edge should not exceed ¼-in.

The committee on construction presented a report with appendices, which makes substantially a manual of road construction. The outstanding recommendations were: (1) No materials should be stockpiled on the subgrade but hauling may be allowed providing the subgrade is fully restored, rolled with a 50-lb. roller, moistened and checked by templet. (2) In mixing concrete a measured aggregate should be used with cement added directly from bags or brought in covered containers, and the mixing period should be at least 1 minute. (3) Central mixing is permissible, (4) The surface finish should be to ¼ in. for pavement and to ½ in. for base.

A 200-page report was presented by the committee on tests. Complete directions are contained for sampling and conducting tests on all classes of road materials. This report was adopted as the tentative standards of the association and ordered to be printed.

After three years the committee on relations with contractors presented a report embodying practically all the features outlined in the statement published in *Engineering News-Record* Nov. 2, 1922, p. 749. The report was accepted without criticism.

An important concluding action of the convention was the authorization of a paid assistant to the secretary to carry on the legislative work and other business arising during the year.

The Engineer in Public Life

JOHN R. FORDYCE

In the civic activities of Hot Springs, Ark., Lt.-Col. John R. Fordyce, president of the engineering corporation which bears his name, has long been active. As a member of the city's Business Men's League he has served on that organization's committee on relations with Washington and made many trips back and forth to the national capital in the interests of Hot Springs, involving relations with the Interior Department and the location of a hospital for ex-soldiers. He is a member of the local Rotary Club and was appointed by Governor McRae as one of the two commissioners of the State Highway Department. He also served as chairman of a voluntary highway commission, appointed by the governor, to study highway development in Arkansas.

During the World War Mr. Fordyce served, with rank of major, Engineers, in this country, on the construction of Camp Pike at Little Rock and the Quartermaster Depot at St. Louis. Later he was assigned to the Railroad Administration as terminal engineer for the Mississippi Warrior Barge Line. He holds a commission as lieutenant-colonel in the Engineer Reserve.

Colonel Fordyce was born in Huntsville, Ala., Nov. 7, 1869, and is a graduate of Washington University, class of 1892, and of the Harvard Graduate School.

Fire Does $15,000,000 Damage to Astoria, Ore.

(*Concluded from p. 1041*)

the curb lines was a fire wall of building tile with some crosswalls at street intersections. These crosswalls had been badly broken by various public service corporations in constructing pipe lines and conduits, leaving an open passage under the streets which acted as a flue and through which the fire ran, setting buildings ablaze sometimes a block ahead of the fire fighters.

"There is no doubt that, had the streets been filled, the fire would not have spread over more than one or two blocks. There were a number of buildings in the burned area of brick, brick and tile, and concrete. With, I believe, only one exception, the brick and brick and tile buildings are completely ruined, while the concrete appears very little damaged. There are also a number of blocks where the concrete walls are carried on reinforced-concrete posts and girders, and I have not yet found a failure of these posts or girders.

"The results of the fire will be: (1) The widening of all streets to not less than 70 ft., they now being nearly all 50 ft. in width; (2) the construction of concrete retaining walls along the curb lines; (3) construction of concrete posts and girders for carrying sidewalks; and (4) the filling of streets with either earth or sand."

Denver Wants Local Engineer as Chief on Moffat Tunnel Job

With the appointment of Major L. D. Blauvelt as state highway engineer of Colorado, comes the announcement that the Moffat Tunnel Commission is soon to select a chief engineer. Inasmuch as Major Blauvelt decided to stay with the highway board, the Colorado Society of Engineers has communicated with the chairman of the commission urging the appointment of a local engineer as chief in the Moffat tunnel work.

As the commission is looking about for an engineer, word is received to the effect that opponents of the Moffat tunnel construction job, represented by a local attorney, have filed a petition for a rehearing of the tunnel bond issue case, based on the claim that the tunnel act violates the constitutional provision prohibiting the use of public credits or bonds in aid of private corporations.

Typhoid at Franklin Furnace Due to Cross-Connection

The typhoid outbreak at Franklin Furnace, N. J., which, up to Dec. 11, had caused 97 identified cases and 14 deaths, has been traced by the staff of the New Jersey Department of Health to an open gate valve and a rusty check valve on a forgotten cross-connection between the industrial and fire protection supply of the New Jersey Zinc Co. and the domestic water-works system. The latter system is owned by the company named but it supplies water for domestic use without charge.

The borough supply is taken from an artificial lake in which water from the Walkill River is impounded. After filtration and chlorination the water is pumped to a standpipe. The industrial supply is also taken from the Walkill River by pumping but at a point below the domestic intake. This supply is not treated.

Two ordinary gate valves on cross-connections were exposed by digging, one of which was found sealed and the other one open. Beyond the open gate valve was the rusty check valve already mentioned. Use of a colored chemical showed that this valve passed water from the mill to the borough system. A recent underwriters' test of the fire-protection system put a heavy extra pressure upon it. The outbreak has been confined to that part of the borough endangered by the open gate valve and the leaky check valve.

The earliest cases were reported on Oct. 24. The open gate valve was closed on Nov. 27.

The portion of Hardyston township that includes Franklin Furnace became Franklin Borough in 1912, and had a population of 4,075 by the census of 1920.

Conference Favors Plan To Number Steel Grades

After extended discussion of the problem involved in the numbering of steels, the conference called by the American Engineering Standards Committee, at the request of the Bureau of Standards, decided the matter could be handled better by a sectional committee of the American Engineering Standards Committee. For that reason no plan or program was adopted so that the sectional committee could consider the matter without limitations as to whether the classification be based on chemical analysis, heat treatment or physical tests.

It was the sense of the conference that there should be a uniform numbering system for forging, casting, structural, tool and other steels, including structural plates.

San Francisco Engineers Hold Tenth Annual Meeting

The San Francisco Engineer's Club celebrated its tenth anniversary on Oct. 31 with a luncheon at which nine of the ten past presidents were present and the tenth, W. W. Briggs of the Westinghouse Lamp Co., spoke to the meeting from his office in New York by means of the transcontinental telephone. Seven other members of the San Francisco Engineers' Club were gathered in Mr. Briggs' office in New York for the occasion and for a period of fifteen minutes during the luncheon there was an exchange of greetings between members in New York and San Francisco. The other members in Mr. Briggs' office were: Allen Hazen, A. M. Hunt, F. W. Gay, Guy Bailey, J. G. DeRemer, C. C. Broadwater, and A. H. Griswold.

After concluding the telephone conversation each of the several past presidents made brief talks and the meeting then listened to an address on "What Shall We Do With Our Past Presidents?" by George L. Dillman. New officers of the club, recently elected for the year beginning Nov. 1, are: President, W. G. Vincent, Jr.; vice-presidents, F. L. Sizer and Bruce Lloyd; secretary, C. H. Snyder.

New Unit in Service at Copco Hydro-Electric Plant

On Nov. 7 a new generating unit driven by an 18,600-hp. reaction turbine was put in service at the Copco plant of the California-Oregon Power Co. which is on the Klamath River just south of the Oregon-California line. The transmission lines of this company extend from Redding in northern California to Eugene in Oregon and while serving the power needs of intervening territory constitute a connecting link between the interconnected power lines of California and the network centering at Portland in the Columbia River Valley.

The new unit is housed in an extension of the power house for which provision was made when the first installation, a unit of the same size, was put in several years ago. The plant is served by a dam across the Klamath River, 132 ft. high above stream bed; the power house standing close to the downstream side of the dam. Additional storage for the new unit was provided by a recently completed 15-ft. increase in the height of dam made in accordance with plans laid out when the first work was done.

Place A.A.E. Employment Service on Self-Sustaining Basis

In response to a desire of the members that the employment service of the American Association of Engineers be enlarged, a plan for putting the service on a self-sustaining basis has been worked out after two years' study. The new plan is not put forth as all-inclusive but rather as the beginning of a method that can be modified in the light of further experience.

Rules under which the service will work stipulate that members only in good standing may receive service (except when qualified members are not available); that the charge shall be 10 per cent of the first month's salary, (except when the position is not more than two months in extent); and that chapters have the option of conducting free or self-sustaining service with the approval of the director of the district who is charged with the direction of all employment work in his district.

Law Protecting Surface Over Mines Found Unconstitutional

With one dissenting voice the U. S. Supreme Court on Dec. 11 declared unconstitutional the so-called Kohler law of Pennsylvania, passed by the last legislature, designed to protect the surface over anthracite mines against subsidence due to the mining operations. Most of the anthracite mining is carried on under various forms of agreement between coal owner and surface owner which give the former the right to mine regardless of surface effect.

The city of Scranton, among others, has suffered increasingly under this system. The Kohler law was designed to remedy the resulting evil conditions by prohibiting the mining of coal in a manner that would endanger lives or property on the surface. The Supreme Court now finds that this law transcends the state's police powers. Its decision states in effect that while exercise of police powers often constitutes a taking of property, in this case the taking is too extensive, and, furthermore, the law is not justified as a protection of personal safety.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Philadelphia Section of the American Society of Civil Engineers at its regular meeting on Dec. 4 was addressed by Nelson P. Lewis, director of the survey of New York and its environs under the auspicies of the Russell Sage Foundation, who spoke on the subject of "Regional Planning." The paper was illustrated by numerous lantern slides showing the scope of the survey and some of the benefits resulting from good planning and from zoning. Milton B. Medary, architect, John A. Vogleson, chief engineer of the Bureau of Surveys and James W. Follin, chief engineer of the Bureau of Municipal Research, all of Philadelphia, took part in the discussion. Preceding the meeting Mr. Lewis was entertained at an informal dinner at the Engineers' Club.

The Associated Engineering Societies of St. Louis is planning a series of radio talks by engineers on the proposed bond issues for public improvements. A lecture on "The Arrangement of Atoms in Crystals" was given Dec. 6 by W. P. Davey, of the General Electric Co.'s research department.

The Engineers Club of St. Louis, Mo., has nominated the following officers for 1923: George E. Chamberlin, president; J. L. Hamilton, J. D. Robertson and W. W. Horner, vice-presidents; L. A. Day, treasurer, and F. C. Woermann, E. H. Tenney and W. R. Crecelius, directors.

PERSONAL NOTES

J. G. KENAN, formerly with P. T. Clifford & Son, general contractors of Valparaiso, Ind., announces the incorporation of the J. G. Kenan Co., with offices at Cleveland, Ohio. The company will conduct a general contracting business, giving special attention to railroad and industrial building construction.

BRIG.-GENERAL MORRIS B. PAYNE, engineer and architect of New London, Conn., has been appointed quartermaster-general on the staff of Governor-Elect Charles A. Templeton, of Connecticut.

JOE J. ESTILL, an assistant engineer with the Tarrant County, Texas, Highway department, has been appointed principal assistant engineer of the department under R. V. GLENN. Mr. Estill was graduated as a civil engineer from the University of Texas in 1912. During the war he served as a captain of engineers and later was associated with the firm of Lipscomb and Estill, contractors, at Ft. Worth, until joining the forces of Mr. Glenn.

A. J. ADCOCK has been appointed county engineer of Reeves County, Texas, with headquarters at Balmorhea.

TOM C. MEAD, until recently an office assistant in the division of irrigation and engineering of the California State Board of Public Works, has become an office assistant in the state engineer's office of Wyoming.

JOSEPH KLECKA, formerly a draftsman with the Pittsburgh Bridge & Iron Works stationed at Rochester, Pa., has become connected with the Morava Construction Co., Chicago, Ill. The latter concern is a steel fabricating organization and Mr. Klecka is employed as draftsman.

MAURY A. CHURCH, formerly a resident engineer in charge of highway construction with Carter & Knoch, civil engineers of Little Rock, Ark., has severed his connection with that organization to become associated with Louis Rich Construction Co., East St. Louis, Ill. His new position is that of construction engineer.

J. R. GUPTILL has severed his connection with the Empire Companies, Bartlesville, Okla., with whom he was employed as engineer, to join the River Junction Farms, Inc., of Oakland, Cal. Mr. Guptill is field engineer in his new position.

R. A. DALE, until recently a district engineer with the Wyoming State Highway Department, has established engineering offices at Glendo, Wyoming, where he will carry on general engineering practice.

R. L. HEARN, formerly assistant engineer of design of the Queenstown-Chippawa power development, is now assistant chief engineer with the Washington Water Power Co., Spokane, Wash. Mr. Hearn is a graduate of the University of Toronto. He has been successively draftsman with the Dominion Bridge Co., Ltd., Lachine; designer with the Hydro-Electric Power Commission of Ontario, on the Wasdells Falls power development, and shop inspector on the Eugenia Falls development.

FRANK H. FOX, formerly electrical engineer with Burns & McDonnell of Kansas City, Mo., has joined the organization of Arthur L. Mullergren, consulting engineer, Kansas City, in the capacity of principal assisting engineer.

E. M. SMITH, formerly structural engineer with the Houston (Texas) Light & Power Co. and the Sinclair Refining Co., has joined the organization of Arthur L. Mullergren, consulting engineer, Kansas City, Mo., as structural engineer.

J. E. CLAYTON, who has been an inspector in the state highway department of Kentucky, has gone to Florida to become associated in highway construction work at Pensacola for the Speed-Parker Co.

GEORGE H. NOLAN, who has been general manager in Cuba for the Frederick Snare Corp., contractors of New York City, has resigned that position and has become vice-president of the Clark Dredging Co., Miami, Fla.

C. H. EIFFERT was appointed maintenance engineer of the Miami Conservancy District, it has been announced by CHARLES H. PAUL, chief engineer, on Dec. 1. Mr. Eiffert has been division engineer in charge of the river improvement work at Hamilton since the beginning of construction about five years ago. Before that he was engaged on the preparation of plans and specifications for various features of the project. He is a graduate of Cornell College, Iowa, and a member of the American Society of Civil Engineers. The creation of the office of maintenance engineer marks a definite step in the change of the Conservancy organization from a construction to a maintenance basis. The flood-control works are practically complete, and have been ready to handle floods for the last year or more. As the upkeep and maintenance of the various features of the project are of principal importance now, the maintenance engineer will be directly responsible to the chief engineer's office for that feature of the district's operations.

FRED F. MCMINN has been appointed structural engineer in the Cincinnati Building Commissioner's office, succeeding RUSSELL M. EASTON, who resigned to accept an executive position with the Ohio Building & Construction Co. Mr. McMinn has served as engineer for the Rapid Transit Commission from the inception of the rapid-transit project, and has supervised much of the construction which has already been completed.

CHARLES E. HEWES, city manager of Long Beach, Calif., has been removed from office by a recall vote. The recall of Mr. Hewes is interpreted by local political observers as a condenmation of the existing council. Various political charges were made against Hewes, which are all in the nature of those to be expected when there is a possibility of removing by a recall vote a city official whose position is appointive.

THE FULLER ENGINEERING CO., whose chief office has been maintained at Allentown, Pa., announces the establishment of headquarters at Fullerton, Pa. The Fuller company has branches in New York, Chicago, Seattle, London, and Hamburg.

STONE & WEBSTER, INC., has recently opened a branch office in Philadelphia at 307 Real Estate Trust Building, with GEORGE CHAMBERLAIN as manager. The company has several million dollars worth of work under way in that city, including the Jefferson Hospital, a new building for the Insurance Company of North America, a district service building for the Western Union Telegraph Company, and foundations for a power house extension for the Philadelphia Electric Co.

R. T. SENTER, formerly assistant to the president of the Philadelphia Rapid Transit Co., has become vice-president in charge of engineering, succeeding GUY A. RICHARDSON, who has resigned. Mr. Senter's engineering work will include such part as the P. R. T. may take in transit development in Philadelphia.

GEORGE M. SHEPARD has been appointed city engineer of St. Paul, Minn., to succeed OSCAR CLAUSSEN, who recently resigned. MR CLAUSSEN had been city engineer for fourteen years. Mr. SHEPARD, who had been an associate of L. P. WOLFF, consulting engineer, is a graduate of the University of Minnesota. In 1917 he was commissioned a captain of engineers and served in the Hawaiian Islands until 1919. The change in officials was brought about by what is purported to be an effort to increase the efficiency of the department of public works.

R. C. STARR is continuing in the capacity of construction engineer for the San Joaquin Light & Power Co. while carrying on the Merced irrigation development for the Merced Irrigation District in California as engineer in charge of construction.

OBITUARY

F. A. WELLS, vice-president of the Wells Brothers Construction Co., Chicago, died Nov. 28 from injuries received in a street-car accident. Mr. Wells, as a prominent member of the American General Contractors, devoted a great deal of effort toward the establishment of better standards and the general betterment of the construction industry, taking special interest in working for arbitration and fixed fee contracts.

HUGH GETTY, president of the building firm of that name in New York City, died Dec. 4, aged 73 years. From 1916 to 1918 Mr. Getty was president of the Building Trades' Employers' Association, and as a result of the "housecleaning" following the Lockwood revelations he was re-elected to the office in February, 1921.

JAMES REAVEY, for twenty years assistant chemist in the San Francisco Department of Public Works, died Oct. 10.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Suggestions by Manufacturers for Contractors—

Better Equipment Maintenance and Repair Parts Service

MANUFACTURERS of construction equipment and materials have often stated that the service of their machines could be vastly improved and their relations with customers made mutually more valuable if purchasers would pay more attention to plant inspection on the job, make repairs in time and keep on hand an adequate supply of spare parts.

In wiring or writing for repair parts contractors cause many misunderstandings by failure to be specific. They may send in a rush order for a "clutch" for a machine on which several different clutches are used or for a "wheel" when front and rear wheels are of different sizes. Requests for filling orders frequently come to manufacturers from individuals whose credit standing is unknown to them.

All of this has suggested the desirability of putting on record a few of the experiences of equipment manufacturers in the supply of repair parts for their machinery. The object, of course, is constructive. The interests of the maker and the user of equipment are identical in this respect: Both want their machinery to render the maximum service on the job.

In this issue, therefore, begins a recital of some of the difficulties with which manufacturers have to contend and of some of the ways in which contractors and other users of construction equipment can cooperate in the interests of better service.

Without further introduction, therefore, it seems desirable to get down to specific cases by the following statements of the experiences of leading manufacturers.

From a Manufacturer of Pneumatic Tools and Compressors

THE difficulty with the majority of purchasers of labor saving equipment is carelessness in its upkeep. Neglecting to keep nuts set up tightly causes most of the grief. Some people think the manufacturer should provide means for locking nuts so that they will remain permanently tight. They lose sight of the fact that it is easier said than done. If it was easily accomplished there would not have been in excess of one hundred thousand patent applications covering various types of self-locking bolts, nuts, lock nuts, etc., to accomplish it. These safety devices all fail sooner or later and having accustomed oneself to rely upon them, havoc is the consequence when they do fail. The only safe plan is to look the equipment over almost daily. The increased efficiency of the equipment will pay for the effort.

When ordering parts it is too frequently the customer's habit to order by description instead of referring to parts catalogues and drawings and making use of the manufacturer's symbol numbers. When customers call a part what they think it ought to be named, instead of following the catalogue, they frequently get what they do not want, with consequent loss of time which is expensive.

Lubricants Important

Many classes of machinery require special lubricants, but users are too prone to ignore the recommendations of the builders of the equipment and take the word of the oil salesman who claims that what he has is better and costs less. When this is done there is usually quite a charge against the educational account. On reciprocating parts, such as pistons provided with rings, when rings break operators wonder at it, but no change is made in the lubricant. If the lubrication is good, rings will not break—they break only when dragging against cylinder walls for lack of lubrication or oil film.

On equipment with splash lubrication, the builders caution the users to change the oil at given periods and to provide quarters to refilter the oil removed from the crank case, but in too many cases the users keep adding additional oil to the old oil in the crank case until it becomes so badly fouled that cross-heads and guides are destroyed.

From the Lakewood Engineering Co., Cleveland, Ohio

IF WE attempted to enumerate the different ways that we receive orders for repair parts and to point out the combinations which contractors seem to hit upon and which fail to give us complete information, the list would be too long entirely for your use. The principal failure on their part is to give the serial number of the machine and the part number from the repair list. The two foregoing points are the most important from our standpoint, coupled with the fact that contractors in general do not seem to attempt to anticipate requirements for many parts of their machines which are subject to a slow wearing process.

We keep a special part of our shop set aside so that special repairs which we do not regularly carry in stock can be handled quickly. We have a separate repair order department and a separate repair order shipping department, all of which is for the sole purpose of giving the quickest possible service on repair parts.

We have made test shipments between express, parcel post and special delivery to determine which branch of the transportation service can best serve certain parts of the country. We send out at this time of the year, as we did two weeks ago, letters urging contractors to overhaul their machines in the early part of the winter and to send their repair orders in now so as to utilize their men who are usually kept on all of the season and to insure readiness for operation when next year's work opens. One specific cause for difficulty which has happened two or three times in the past six weeks has been the order for repair parts from the home office of the customer and failure to indicate to which job this machinery part is to be shipped, although there may be several jobs running.

Next Week: Experiences of the Western Wheeled Scraper Co., Aurora, Ill.

Next Week

"I want rear wheels, hind wheels, back wheels. Dammit"

The contractor who sent this telegram to an equipment manufacturer could have avoided getting all "het up" if he had ordered "rear wheels," instead of just "wheels."

This incident, and others within the experience of the Western Wheeled Scraper Co., Aurora, Ill., will be discussed in next week's issue. The article will indicate to the contractor who "wants what he wants when he wants it" how to get it—*Editor.*

To Protect Boxed Freight Shipments in Transit

The Transportation Division of the Bureau of Foreign and Domestic Commerce has recently investigated the best practices in export packing. Valuable suggestions have been received from many sources, among them one from the freight claim division of the American Railway Association, advocating the use of steel box strapping, which has the approval of the division, as an efficient method of reducing annual loss from pilferage and from inadequate containers, aggregating many millions of dollars.

A case reinforced with steel binding is protected against pilferage. Rapid removal of a steel banding is not possible with the tools usually at hand nor can a cut wire or strap be easily reunited. Wire or steel strapping adds to the strength of a container in a proportion so far above its slight cost that a box designed to carry its load without reinforcement can frequently be supplanted by one having sides, top, and bottom of the next thinner commonly used box lumber, provided it is adequately reinforced by a wire or strap binder. The result is a stronger, lighter, and less expensive box.

One big concern reports that a large percentage of its shipments is strapped, and that since adopting this system its package troubles, both from damage and pilfering, decreased 42 per cent during a period in which shipments increased 20 per cent in number.

Tell Road Show and Convention Story in Graphic Form

Manufacturers and "Engineering News-Record" Donate Space in Big Promotional Effort

TWENTY-TWO manufacturers of road building equipment and material and the publishers of *Engineering News-Record* have joined forces in a campaign to secure for the American Road Builders' Convention and Good Roads Show in Chicago, Jan. 15-19, not merely a record-breaking attendance of engineers, contractors and officials of the federal government, state, cities and counties throughout the country, but to double the figures of last year's unprecedented meeting. This effort has taken the form of a combined advertisement of 23 pages in this week's issue telling the story of what promises to be the greatest assemblage of the men, the machinery and the materials behind the nation's program of highway development ever brought together in this or any other country.

The various committees this year have been tireless in their efforts to make the January meeting one of outstanding usefulness to the entire highway industry. Careful planning has governed the preparation of the technical program. Subjects of major interest have been selected for discussion and the field has been combed to secure the men best qualified to prepare papers.

EXHIBIT SPACE SOLD OUT

As regards the Good Roads Show, every square foot of the enormous area covered by the Coliseum and adjoining buildings has been subscribed for by exhibitors, with the result that there will be on display new types of road-building equipment and materials and improvements on old types which in number and variety will surpass all previous exhibits in this field.

The Publicity Committee felt that the unusual character of this year's road convention and show demanded other than ordinary methods of promotion—some comprehensive, forceful plan to arouse the entire industry to the opportunities offered by the Chicago meeting. Out of this thought was developed the plan for using an imposing quantity of advertising space. This space, it should be noted, has been donated by the manufacturers of equipment and materials and the publishers of *Engineering News-Record*, not to feature their own products but to tell the story of the convention and by this widespread publicity, assure the attendance not only of the maximum number of highway engineers and contractors, but also of the leaders of the industry.

Construction Equipment Exported

Figures for September, 1922, of domestic exports of power shovels, dredging machinery, cranes, hoists and derricks, have just been issued by the Bureau of Foreign and Domestic Commerce. During the month indicated 13 steam and other power shovels, valued at $108,430, were shipped, 8 of them going to Canada, 2 to Japan and 1 each to England, Australia and Algeria. Dredging machinery exports totaled 302,245 lb. priced at $48,417; Australia was the largest consumer with 31,100 lb. Sixteen cranes costing $49,643 were exported, 4 going to Canada and 4 to Brazil. Hoist and derrick exports showed a total number of 233 units valued at $61,753; 62 of these units were shipped to Japan, 30 to Canada, and 41 to Australia.

S. B. Newberry

Dr. S. B. Newberry, president of the Sandusky Cement Co., and for years one of the leaders of the Portland cement industry, died suddenly Nov. '28 while driving his car in the downtown district of Cleveland. Dr. Newberry was born in 1857. After graduation from the School of Mines of Columbia College in 1878 he studied in Germany and France from 1879 to 1881. From 1881 to 1892 he was in the chemistry department of Cornell University, finally becoming professor of chemistry at that institution.

In 1892 he left collegiate work to become general manager and consulting engineer for the Sandusky Portland Cement Co., where he remained until his death. In addition to the executive control of the company Dr. Newberry had intimate contact with all the technical problems of cement manufacture. His investigations dealt particularly with the matter of waterproofing concrete and the manufacture of white cement. For many years he has been a familiar figure at all cement and concrete meetings.

Imported Shingles May Escape Duty Under New Tariff Act

Washington Correspondence

As a result of the alphabetical arrangement of the free list of the new tariff act, building interests may find that they can import asphalt shingles and asbestos shingles without payment of duty. Under the Underwood tariff act of 1913, composition shingles were assessed for duty according to their component material of chief value. Wooden shingles were free under that act, and it was clear that only wooden shingles were intended to be free, as they were classified in the free list among other woods.

In the new tariff act the free list is arranged alphabetically and the single word "shingles" appears between other items entirely foreign to the subject. The Treasury Department is studying the subject and while no ruling has been made the indications are that all shingles of whatever material must be admitted free.

Manufacturer Creates Fellowship for Steel Pipe Research

An industrial fellowship in the Mellon Institute of Industrial Research, of the University of Pittsburgh, has been established by the National Tube Co., of Pittsburgh, for systematic study of practical methods for the prevention of corrosion in hot-water supply systems. It is also giving attention to the classification of waters of various chemical composition, with respect to their relative corrosive action upon iron and steel, particularly in the form of pipe lines, boiler-economizers, tubes, etc. The present incumbent of the industrial fellowship is Clifford R. Texter, who for the past several years has been carrying out research on the corrosion of iron and steel, where not exposed directly to the atmosphere.

Business Notes

BABCOCK & WILCOX CO., manufacturers of boilers, have discontinued their branch office at Fort Worth, Texas, and established a new office at Dallas in the Magnolia Building.

CALIFORNIA EQUIPMENT & SUPPLY CO., dealers in construction and industrial equipment, Los Angeles, Calif., has completed arrangements to represent the American Cement Machine Co., Keokuk, Iowa, manufacturers of concrete mixers and hoists. The California company is planning to extend its business by including a general line of contractors' equipment.

J. R. SHERMAN has recently been admitted as a firm member of the Yakima Cement Products Co., Yakima, Wash., which is engaged in the manufacture of concrete pipe and other cement products. He recently completed the revision of plans and estimates of the irrigation system for the Kittitas reclamation district near Ellensburg, Wash. The work of the district, however, is suspended temporarily until a new bond issue is voted. An election will be called soon and in the event of a favorable vote on the bonds it is hoped that construction work will begin early next year.

TYREE L. BELL, president Tyree L. Bell Equipment Co., Dallas, Texas, representatives for the Lakewood Engineering Co., has become associated with McElwrath & Rogers, contractors of Corsicanna, and will supervise their road work in Cameron County, at Brownsville. He will maintain his interest in the equipment business which will be conducted by Donald Lee, sales engineer.

L. H. BEACH, formerly manager of the power plant department of Weinshank & Fenstermaker, consulting engineers, Indianapolis, has opened an office as commercial engineer in the Traction Terminal Building, Indianapolis, to represent the Permutit Co., of Chicago, manufacturers of water softening equipment, in the Indiana territory.

AVERY CO., Peoria, Ill., announces its improved 25-50-hp. tractor. Except for increased power, the design follows closely that of the 20-35-hp. unit described in this journal Nov. 30, 1922, p. 955.

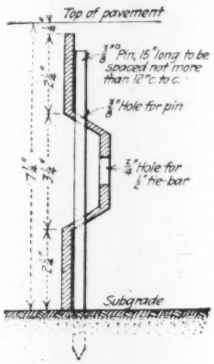
H. GOLDBERG has recently organized a pipe supply concern under his own name at 305 Cherry St., Philadelphia. For the past eighteen years he has been connected with the tool and used equipment business. For two years he was with the American Pipe & Supply Co.

Equipment and Materials

Bituminous Felt Joint Has New Tongue-and-Groove Feature

A new form of Elastite premolded expansion joint for concrete roads, embodying a tongue-and-groove feature instead of the straight face joint extensively used in the past, is announced by the Philip Carey Co., Cincinnati, Ohio. It has been developed, its manufacturer states, to fill the need of a longitudinal joint for concrete roads that would (a) prevent spalling and crushing of concrete at the joint, due to slab movement; (b) maintain a watertight seal in spite of possible movements of adjacent slabs; and (c) by interlocking action hold adjacent slabs to the same surface alignment, thus making it impossible for one slab to be forced up above or settle below its neighbor.

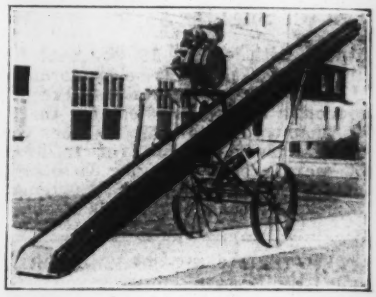
The new tongue-and-groove joint is made of the same material as the straight-faced joint and consists of a body of asphalt compound reinforced on each side with a heavy sheet of asphalt-saturated felt. The new joint is supplied in thicknesses of ½ and ¾ in., in widths from 4 to 12 in., and in any lengths up to 10 ft. To support the joint in position prior to concreting steel pins are passed through holes punched in the joint material, as shown in the accompanying sketch and driven into the subgrade. For longitudinal center-line joints the ½-in. thickness is recommended and for transverse joints the ¾-in. thickness. This form of tongue and groove joint has been accepted by the Illinois and the Michigan state highway departments. The sketch herewith is reproduced from the Illinois highway department's new standard sheet of concrete road sections.



Light Portable Conveyor for Sand Stone and Gravel

Designed originally for handling coal, the continuous-belt scoop conveyor manufactured by the Portable Machinery Co., Passaic, N. J., was modified this year in order to adapt it to the use of general contractors in loading sand, gravel, and crushed stone. Mounted on a two-wheeled steel carriage, the equipment consists of an inclined trough and belt conveyor operated by either an electric motor or a gasoline engine carried above the belt on vibration-reducing supports. The machine is made in three sizes—with 20-, 25-, and 30-ft. conveyor—and weighs from 1,500 to 2,300 lb., depending on type of power equipment and length of conveyor boom.

Simplicity of design was sought by eliminating self-propelling mechanism and self-feeding attachments. For the smaller-sized machine a maximum loading clearance of 9 ft. is provided and for the larger unit, 15 ft. The height of the delivery end may be varied within a 2-ft. range by a handle on the supporting arm of the wheel carriage. The width of the belt in all types is 14 in. An advantage of the overhead mounting of the power equipment is claimed to be its accessibility and protection from dirt. Under average operating conditions, the manufacturers claim, with one man feeding, 1 ton of material can be handled in from 2 to 3 min. The fuel consumption is stated to be from 4 to 6 gal. of gasoline per 8-hr. day, while in the case of the electric motor drive the cost of current is given as from 4 to 6c. per hour. The conveyor belt is operated through a chain and sprocket drive and at the feeding end a take-up bearing is provided.



One of the chief differences between the coal-handling and the contractor's type of conveyor is in the carrying trough. In the new sand and stone conveyor the belt travels between skirt plates instead of under them, as on the coal-handling type. This feature is claimed to reduce friction along the trough and to increase the life of the belt. Self-cleaning pulleys are used at both head and tail ends and special bearings are introduced.

Air Given Spiral Flow Through Sectionalized Radiator

Built in sections, so that a damaged unit may be replaced with a minimum loss of both time and money, the Spirex radiator, manufactured by the Modine Manufacturing Co., Racine, Wis., is intended for use not only on motor trucks, but also on a wide range of construction machinery operated by gasoline engines. An exceptionally great cooling capacity is claimed for this radiator due to a special form of spiral core construction, by means of which a copper strip in each air cell produces centrifugal action on a column of air during its passage through the radiator. In addition, extra large water channels allow for constant free flow with a minimum danger of clogging or freezing.

The material used in this design is extra heavy copper radiator stock. The water channels are of one-piece construction with but one seam lapped and soldered inside and out. A ⅜-in. plate of solid metal, front and back of the water channels, adds strength and leakproof qualities.

Publications from the Construction Industry

Tackle Blocks—W. W. Patterson Co., Pittsburgh, has just issued a new catalog showing its line of tackle blocks. The book contains 64 pages, 6x9 in., and illustrates standard wood blocks, oil-well blocks and hooks, snatch-blocks and weight blocks, as built for either manila rope or wire line. It also shows many special blocks, and "C"-hoops, Patterson design hooks, wire-rope slings, steamboat ratchets and contractors' tools. A number of field views complete the work.

Building Mixers—American Cement Machine Co., Inc., Keokuk, Iowa, is distributing a 28-page illustrated catalog and two folders dealing with its line of Boss building mixers. A feature of this equipment, which is built in sizes of from ½ to 5-bag capacity, is the use of a steel roller-pinion drive. In addition to the building mixers there is manufactured a combination building and paving mixer known as the 2-in-1. One of the pamphlets above noted deals with the Boss special highway mixer, which is equipped with pneumatic cord tires; in this machine the manufacturers claim to have saved 1,000 lb. in weight by the use of a steel instead of a cast-iron drum. The second folder features the Packard tilter mixer built in capacities of 3 and 5 cu.ft. and designed to mix mortar or plaster as well as concrete. A trailer model is shown equipped with pneumatic tires, which, it is claimed, add to the life of the engine and mixer by eliminating rattling during moves, jolting and loose bolts.

Overhead Shafting Data Book—Midwest Steel & Supply Co., Inc., New York, in a 54-p. data book for architects and engineers, presents information to aid in solving problems relating to overhead shafting layouts in factory buildings and to the anchorage of various kinds of equipment in connection with concrete and brick work. A number of illustrations are given of the use of the company's "Ankerails," concrete inserts, and steel stringers. The Ankerails are of two types, a box section and an L section. The box rails have a hollow steel section with a continuous longitudinal slot in the bottom flange and vertical stiffening ribs on either side. The data book contains a great many cross-sectional drawings indicating how the box rails may be adapted to a wide variety of industrial uses, involving the anchorage of machinery, monorails, motors and blowers, piping, pier fenders, shaft hangers, shafting stringers. Illustrations show a number of typical layouts for overhead shafting.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Nine Cities

Gain in Steel Output During Month—Cement and Brick Production Increased—Lumber Fell Off Slightly

Steel—Monthly production of steel ingots, as reported by thirty companies which made 87½ per cent of the steel ingots produced in 1921, shows 2,889,297 tons for November, a gain of only 0.5 per cent over the preceding month. The total output, thus far this year, has reached 26,336,563 tons as compared with 15,399,853, for the corresponding period in 1921. Operations in the iron and steel industry, are proceeding at about 80 per cent of capacity, with much headway being shown upon tonnages booked during the strikes.

Lumber—An average of 311 mills reporting weekly, to the National Lumber Manufacturers' Association, show 952,502,697 ft. cut; 794,682,118 ft. shipped and orders for 877,714,760 ft. b.m., for the four weeks ending Nov. 25. This represents a drop of about 4 per cent in production; a gain of 6 per cent in shipments and 17 per cent in orders, over the four weeks, preceding. The industry, as a whole, now stands at about 10 per cent below normal, as to output; with orders 19 per cent and shipments, 20 per cent below normal.

Cement—October shipments exceeded production by 567,000 bbl., for the entire country, according to the Geological Survey. A total of 12,287,000 bbl. were produced during October as against 11,424,000, for September. Shipments reached 12,854,000 bbl. in comparison with 12,444,000, during the preceding month. With an increase of 7 per cent in production, outweighing an increase of 6 per cent in shipments, stocks on hand Nov. 1 amounted to 4,157,000 bbl., a drop of 12 per cent from the previous month.

Brick—Information as of Nov. 1, received from members of the Common Brick Manufacturers' Association, producing 70 per cent of the country's output of common brick, shows that stocks of burned brick on hand increased 21 per cent and unburned, 83 per cent during the month. Orders fell off only 0.4 per cent between Oct. 1 and Nov. 1, 1922. Sixteen plants closed on account of the season. Stocks are piling up in anticipation of the Spring demand.

San Francisco—Fair supplies of track materials, metal lath and hollow tile. Large stocks of road-oils, asphalt, sewer pipe, brick, steel sheets and manila rope. Scarcity of cement, triangle mesh and wire nails. Prompt mill deliveries on reinforcing bars but slight shortage of structural shapes. Lumber being consumed as fast as shipped from mill.

Denver—Brick on hand around 4,000,000, an ample supply for all calls or immediate delivery. Lumber stocks built up in anticipation of demand and are now very complete, in spite of transportation difficulties. Brick plants to operate during cold weather, in view of heavy demand.

Minneapolis—Dealers report conditions of stocks in all building materials, notably better than month ago, due to seasonal falling off in construction operations. About 20,000 bbl. of cement in local warehouses. Dealers able to furnish enough brick. Lumber stocks low, as usual at this time, estimated at about 25 per cent below normal for season.

Detroit—Sewer-pipe stocks small, but sufficient to supply demands. Cement shortage relieved; ample supply for immediate shipment at nearby mills. About fifteen carloads of lime at warehouses, with quick shipments from Ohio and Michigan plants. Hollow tile stocks depleted; large deliveries take several days. Moderate reserves of dimension lumber but scarcity of structural timbers. Asphalt deliveries require one to two days.

New Orleans—Stocks of sewer pipe, cement, lime, brick and hollow tile considered fair; with demand active. Sand and gravel situation better, with no market for crushed stone. Production of Southern pine continues below volume of orders received.

Atlanta—Plenty of common brick and yellow pine lumber. About five

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Cement, Minneapolis, 20,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 6 @ 8 days); and stocks on hand in general terms, example: (common brick, Philadelphia, no surplus).

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Philadelphia	New York	Montreal
Sewer pipe	Plenty	Del. 24 hr., local plant	Improved	Small but sufficient	Stocks fair	Del. take 6 @ 8 days	Stocks depleted	Mill del. better	Ample
Cement	Stocks low	Del. retarded by car shortage.	20,000 bbl.	Shortage relieved	Sufficient	20 cars	Supply low; del. slow.	No shortage	Plenty
Lime	Fair supply	Plenty	Better than month ago	15 cars	Ample	20 cars	Stocks limited; del. uncertain	Plenty	Well supplied
Common brick	Plentiful	4,000,000	Able to supply all orders	Plenty in local yards	Plentiful	Unlimited	No surplus	Enough for this winter; capacity market	Del. take 7 days
Hollow tile	Enough	Sufficient	Supply no longer limited	Depleted	Enough	Del. take 4 @ 6 days	Del. by rail, slow	Well supplied; del. by water	Short; del. take 3 days
Lumber	Used as fast as it arrives from mills	Complete, all dimensions	About 25 per cent below normal	Structural timbers scarce	Production below orders	Plenty pine	Not equal to demand	Mill del. take 7 @ 9 wk. from time order is placed.	Retail stocks large
Asphalt	Large stocks, native.	About 10 cars	No shortage	Del. take 1 @ 2 days	No market	25 cars	Heavy reserves	Plenty in reserve	
Structural steel	Low on shapes	No scarcity reported	Notably better than last month	Enough	No shortage	5 cars	Sufficient warehouse stocks	Heavy warehouse stocks; mill. del. slow.	Well stocked

REPORT ON COMMON BRICK FROM 94 YARDS AS OF NOV. 1, 1922

Dist. No.	Including States of	No. of firms reporting	Plants closed down	Burned brick on hand	Unburned brick on hand	Orders on books	Price per thousand at brickyard
1.	N. Y., New England	7	4	5,877,000	5,515,000	2,590,000	$12.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	10	0	9,062,000	8,052,000	32,648,000	13.50 to 19.00
3.	Va., N. C., S. C., Ga., Fla.	7	0	2,829,000	2,407,000	2,974,000	12.00 to 18.00
4.	Mich., Ohio, W. Va.	11	1	14,906,000	11,107,000	13,453,000	12.50 to 15.00
5.	Ill., Ind., Wis.	25	1	175,792,000	31,511,000	157,298,000	9.50 to 15.50
6.	Ky., Tenn., Miss., Ala., Ark., La.	8	1	4,660,000	3,707,000	9,443,000	9.37 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	8	4	4,255,000	1,838,000	2,153,000	10.25 to 18.00
8.	Okla., Tex., N. M.	6	2	5,611,000	1,701,000	1,390,000	7.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	6	2	1,880,000	801,000	745,000	12.00 to 16.00
10.	Calif., Ariz., Nev.	6	1	7,853,000	10,787,000	10,000,000	11.00 to 15.50
		94	16	232,733,000	77,426,000	232,694,000	

carloads of structural steel; twenty cars each, of lime and cement; and twenty-five carloads of asphalt, on sidings. Hollow tile deliveries take four to six days; six to eight, required on sewer pipe.

Philadelphia—Rail deliveries slow on sewer pipe and hollow tile; stocks depleted. No paving stone or wood blocks; asphalt plentiful. Cement, lime and common brick reserves, low; shipments uncertain. No surplus stocks of lumber, except some few odd sizes; supply inadequate to meet the heavy demand.

New York—Mill shipments of long leaf yellow pine, take seven to nine weeks from time order is placed. Unprecedented shortage of materials in crushed stone market. No new orders being booked; dealers concentrating upon filling of contract obligations. Enough brick for winter needs. Slow mill deliveries on all construction materials.

Montreal—Ample supplies of sewer pipe, cement, lime and other construction materials. Brick deliveries, however, take from three to seven days. Shortage of hollow tile reported. Large retail stocks of lumber.

Business Briefs

Stock market more active, but not because of participation by general public.

Ford Motor Co. capital stock amounted to $17,264,500, its surplus $289,935,296, and its reserves for income taxes (halfway through the year) $44,848,893, according to the last statement.

Steel production was at the rate of 35,555,000 tons per year in November, the largest since November, 1920. Total output of 1921 was only 16,826,946. Pig iron production was at the rate of 94,990 tons per day, against 85,092 in October.

Building contracts of $150,000 and up awarded in the United States this year, to Dec. 1, numbered 1,790 worth $682,986,000, according to Construction News figures of *Engineering News-Record*. These comprised such structures as offices, banks, schools, hospitals, etc., and did not include industrial works, which numbered 1,272 projects worth $40,000 and over, totaling $180,151,000.

Petroleum production in the United States was 63,620,520 bbl. in 1900, and 469,639,000 in 1921. In the ten years from 1912 to 1921 inclusive the Standard Oil Co. of New Jersey, which leads all the oil companies in the volume of business, showed net earnings of $775,163,260, of which $115,517,677 was paid for taxes, $222,065,226 for dividends, and $437,580,357 was absorbed by the business.

Foreign exchange's feature is the strength of sterling, which on Monday closed at $4.59½, the highest since 1919. The New York *Times* says "there is little doubt that England has been buying her own exchange in the open market." Authorities state that the French financial situation is improving and the fact that this improvement has not been reflected in exchange suggests that the franc is more responsive to political events than to the economic situation. The German mark sold for .01 3/16 to .01¼ cent.

Avoid Transportation Waste To Reduce Car Shortage

Loading To Cubical Capacity; Prompt Unloading, Key To Problem—No Cars To Ship Repair Materials

That "the railroad problem has ceased to be merely a problem for the railroads," is the opinion expressed by the National Industrial Conference Board, in its survey of Dec. 3. The report continues: "It has become one of the great industrial problems of the country. It has ceased to be merely a matter of combinations, rebates, rates, regulations and the like. It has become a question as to whether this country shall have a real railroad service administered for the benefit of the country as a whole, or whether a variety of diversified interests, — the farmers, labor, or any other group,— shall seek to regulate the railroads for their own exclusive benefit.

"The railroads have been regulated to the point of debility. Wages, together with working conditions, form a large item of expense. They have been regulated, usually upward, by a government board. Income has been regulated through control of rates, with a consequent progressive reduction of the ratio of earnings to cost of service. Intercorporate agreements which would have permitted desirable operating economies are prohibited. How the railroads—or for that matter any business enterprise—under such conditions, could be expected to maintain service, improve their equipment and roadbed, seek new capital for needed extensions and pay a fair dividend on the invested capital, is a problem for which those who are occupied in framing railroad regulation have offered no solution. Certain individuals and certain groups in Congress are threatening further drastic regulations of the railroads. But so far no comprehensive or intelligent plan for attacking the vital problems involved has been advanced."

No Cars To Ship Car Materials

The situation resolves itself into a condition where there are no cars available to ship materials to build new cars or repair those in bad order. Several car-building and repair companies are having trouble in securing shipments of lumber, already contracted for. Owing to the greatly increased demand for car repair materials and the necessity of putting into use all available freight cars, anything that can be done to expedite the movement of materials to these car companies will not only help the railroads, but will also put more cars in service at an earlier date. Following a decrease in car shortages, consequent to a seasonal decline in freight loadings; as well as a reduction in the number of bad order cars and locomotives, due to gains in employment of shop mechanics, comes the Car Efficiency Circular, issued Dec. 1 by the American Railway Association. This circular embodies an appeal to shippers, made with the full knowledge that railroads recognize their own responsibility for prompt movement, of loaded and empty equipment, as being one of the primary measures necessary to avoid waste of transportation. Among the several important factors contained in the circular, are the following suggestions to shippers and receivers:

(1) In buying other than "less car load" shipments, specify "car loads," not fixed quantities as governed by tariff minimums or set trade units.

(2) Load cars the day placed.

(3) Load to cubical, or 10 per cent above marked capacity.

(4) Unload cars the day received thus releasing equipment and avoiding demurrage.

Car loadings by weeks (Oct. 28 to Nov. 25), as reported by the American Railway Association, during the last three years, are shown in the following table:

Week	1922	1921	1920
Nov. 25	955,495	673,465	803,701
Nov. 18	969,094	790,363	889,138
Nov. 11	953,909	755,777	927,586
Nov. 4	994,827	837,576	915,615
Oct. 28	1,014,480	951,384	981,242

The demand for freight cars in excess of supply, reached 152,565 for the week ending Nov. 23, as against 158,236 cars during the week of Nov. 15, 1922. This represents a decrease in shortages of over 5,000 cars in one week.

Of the 2,258,949 cars on all lines, 235,660 or 10.4 per cent, were in need of repairs on Nov. 15. This shows a slight decrease in comparison with 249,960, in bad order on Nov. 1, 1922.

Union Rejects Award by Jurisdictional Board

Trades Clash Provokes Strikes on New Cleveland Bank—Hoover Regrets Defiance of Board

Washington Correspondence

Much interest is being shown in Washington as to expected developments from the refusal of the carpenters' union to accept the decision of the National Board for Jurisdictional Awards in the building industry, which declared that metal-trimming work properly belonged to the sheet metal workers. The board met Nov. 15 and 16, but withheld announcement of its proceedings for a week.

Attention has been attracted to the attitude of the carpenters in connection with work on the new Cleveland Federal Reserve Bank building, where a clash of interests between the carpenters and metal workers led to a strike of other crafts.

Inasmuch as the Board for Jurisdictional Awards is a voluntary organization, without governmental force, set up to bring harmony to the crafts of the building industry and save loss to all concerned from conflicts over which union shall perform specific classes of work, there has been a special effort to prevent lawsuits and preserve the organization as a mutual give-and-take proposition.

There have been indications recently that the carpenters might ask for a rehearing of the metal trimming case. If this were done before the board at its last meeting, the fact was not made public.

Hoover Interested

Secretary of Commerce Hoover has expressed his views as follows:

"I greatly regret to see the strike in Cleveland from failure of acceptance of the awards of this board. I interested myself greatly in the creation of the board, comprised, as it was, of the representatives of the building trades, contractors, architects and engineers. Its

awards as to jurisdictional limits in the different trades have been universally accepted except in one trade, and it has saved, literally, millions of dollars for the workers, contractors and owners of buildings. Nothing is more impossible to deal with in strikes than quarrels between the trades themselves, and this board bade fair to secure national solution of this entire problem in the building trades.

"It would be a national calamity if there were failure of the public and the workers themselves to support the board's decisions and to require through public sentiment, adherence to them.

"This board represents also the ability of American industry to get together and solve its own quarrels and set up its own standards without official interference, and a voluntary acceptance and good will toward the board by all parties in a community is absolutely essential if we are to make progress in the solution of our many thousands of troubles."

I. C. C. Removes Restrictions on Open-Top Cars

Washington Correspondence

All restrictions on the use of open-top cars have been removed by the Interstate Commerce Commission and all priority of movement of certain commodities has been cancelled. This action was taken Dec. 8 when the Commission issued amendment No. 4 to Service Order No. 5 and amendment No. 2 to Service Order No. 24.

Service Order No. 22 is the only general service order still outstanding. This order directs all common carriers to forward traffic to destination by the routes best calculated to expedite its movement and to relieve congestion. There are a few orders outstanding, dealing with the placement of cars to meet individual and specific emergencies.

Next week—résumé of recent public bond sales, showing rate, yield, price and by whom handled.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	—$3.50
Structural rivets, 100 lb.	3.85	4.60	6.00	3.75	4.00	4.80	4.75	4.25	+6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.92½	3.05	—3.62½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	53.95%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	—54.30	—45.82	55.00	+51.20@52.20	—54.16	63.61	+54.00	—53.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	36.00	46.00	+52.00	+40.75	39.75	35.00	23.50	50.00
Lime, finishing, hydrated, ton	16.80@ 17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	+18.00@19.10	11.50	9.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	+ .0859	.115	....	.0796	.065	....	.11	+.115
Hollow partition tile 4x12x12, per block	.1230	+.0859	.115	— .0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.90	—.96	—1.05	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.37). Bab charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

General downward trend of coke and pig iron prices, finds basic and No. 2 foundry iron at $25 per ton, Pittsburgh, including freight from valley. This is a drop of $2.50 per ton during week. Current price of steel shapes at minimum of $1.90 per 100 lb., f.o.b. mill, for delivery in first quarter of 1923. As high as $2.10, however, has been quoted on orders for immediate shipment. Plate tonnages are not being placed so readily; quotations now $1.90@$2 per 100 lb., Pittsburgh. Plate buying mostly for tank construction and railway use. Reinforcing bars, $1.90 for first quarter delivery; current business still at $2 per 100 lb.

Lumber price situation strong, for the present, with rises reported in two important centers. Chicago quotes yellow-pine structural timbers (base sizes) at $52, up from $51; and Minneapolis reports Douglas fir at $40.75, advanced from $39.75 per M ft. b.m.

Rise of $1 per M in common brick, on New York market, attributed to unusual demand for this season of the year. Brick now $18@$19.10, delivered to job, as against $18@$18.55 per M., last week.

Linseed oil market firmer in most cities; declines reported, however, of 1c. in Atlanta and 2c. per gal. in Dallas.